MARKET OPPORTUNITIES IN DISCRETE MANUFACTURING

INPUT

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OFFICES

Headquarters
1943 Landings Drive
Mountain View, CA 94043
(415) 960-3990
Telex 171407

Dallas
Campbell Center II
8150 N. Central Expressway
Dallas, Texas 75206
(214) 691-8565

New York
Park 80 Plaza West-I
Saddle Brook, New Jersey
(201) 368-9471

United Kingdom
INPUT, Ltd.
Airwork House (4th Floo
35 Piccadilly
London, W.1.
England
01-439-4442
Telex 269776

AFFILIATES

Australia

Sweden
P.O. Persson Konsult AB
Box 221 14
Hantverkargatan 7
104 22 Stockholm
Sweden
08-52 07 20

INPUT Planning Services for Management

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MARKET OPPORTUNITIES IN DISCRETE MANUFACTURING

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EXHIBITS

1 INTRODUCTION

I INTRODUCTION

A. PURPOSE AND SCOPE

- This study is produced by INPUT as part of the Information Services Industry Program (ISIP).
- The purpose of the study is to examine the use of data processing (DP) products and services in the discrete manufacturing industry. Included are:
  - A description and definition of the industry.
  - User attitudes and perceptions of EDP services.
  - A forecast of user requirements and expenditures.
  - An analysis and forecast of the various products and delivery modes.
- The scope of this report is limited to U.S. noncaptive expenditures on information services. Industry data pertain to U.S. companies only.
- Forecasts are presented for the following vendor delivery modes:
  - Integrated systems.

- Processing services.
  - . Remote computing services (RCS).
  - . Batch services.
  - . Processing facilities management (FM).
- Applications software products.
- Systems software products.
- Professional services.

- Delivery mode forecasts are segmented into the following categories for analysis:
  - Function-specific, for applications that cut across industry lines or represent more general purpose applications such as payroll and general ledger.
  - Industry-specific, for applications unique to an industry or industry subsector such as numerical control tape preparation and electronic test pattern generation.
  - User-functional areas:
    - . Engineering.
    - . Manufacturing.
    - . Business/finance.

B. METHODOLOGY

1. DIRECT RESEARCH

- Primary research for this report consisted of interviews with 52 users and 10 vendors.
- User respondent companies were randomly selected from a variety of sources.
- Vendor respondents were selected to represent a range of company sizes and product delivery modes.
- The research questionnaires used for this study are in Appendix D.

2. ADDITIONAL SOURCES

- In addition to the primary research, a number of other sources were used, including:
  - U.S. government publications.
  - Other INPUT studies.
  - Recent trade and industry publications.
  - Vendor literature.
- A detailed listing of government and INPUT studies used is in Appendix C.

3. ASSUMPTIONS

- The base year for forecasting is 1981. Forecasts are presented for the years 1982 through 1987.

- All dollar figures are stated in current dollars.

- An inflation rate of 10% per year has been assumed through 1987 based on projections for the Producer's Price Index.

- Information services vendors' price increases due to inflation are forecast to be:

  - Integrated systems: 8% per year.

  - Processing services: 6% per year.

  - Software products: 4% per year.

  - Professional services: 8% per year.

- The differences between the inflation rate and projected price increases are due to a number of factors including:

  - Vendor productivity increases.

  - Competitive pressures.

  - Market demand.

  - Improved hardware price/performance ratios.

C. QUALIFICATION OF RESULTS

- Sample sizes may not be statistically significant in all cases: such results should be treated as indicators only and inferences drawn with caution.

- Data have been rounded in many cases to facilitate analysis and reduce any implication of an unwarranted degree of accuracy.

  - Forecast growth rates have been calculated based on expenditure numbers rounded to nearest million.

  - Actual numbers used in the forecast may be found in Appendix B.

D. FORECAST METHODOLOGY

- The market forecasts in this volume are based on a number of factors:

  - The overall framework is established by INPUT's ISIP Annual Report forecasts.

  - The ISIP forecasts are based on a census of all information services vendor firms of over $10 million in revenue, and a sample of smaller firms.

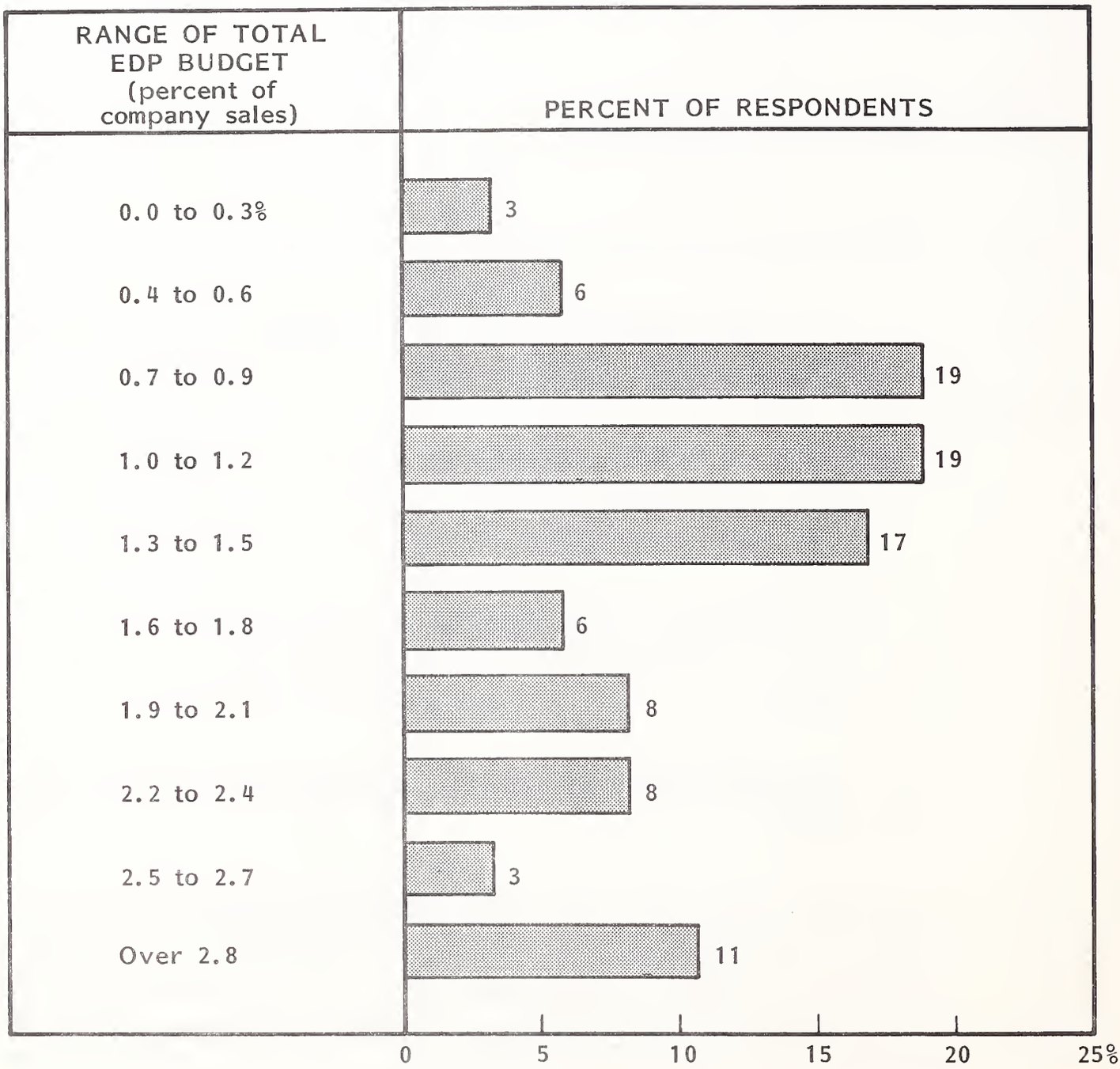
  - The integrated forecasts were obtained by the same technique in INPUT's CAD/CAM Multiclient Study market analysis and forecasts volume.

- INPUT sampled user expenditures in two independent surveys and received similar results.

- Fifty discrete manufacturing firms were surveyed for the INPUT Information Systems Program 1981 Annual Report. They reported total DP-related expenditures equivalent to approximately 1.5% of their annual shipments, as shown in Exhibit I-1.

EXHIBIT I-1

RATIO OF EDP BUDGET TO COMPANY SALES: DISTRIBUTION OF RATIOS AMONG RESPONDENTS IN THE DISCRETE MANUFACTURING SECTOR



SOURCE: INPUT, Information Systems Program, 1981 Annual Report

- User research conducted for this report yielded comparable results, as shown in Exhibit I-2.

- Forecasts for the individual delivery modes are broken down by service type and functional area. Assumptions are developed for current spending patterns by each functional area for a given service type, such as the percent of specific RCS spending for engineering, manufacturing, and business. These assumptions are based on research for this report and the ISP Annual. Survey responses and the judgment of INPUT senior staff members yielded expenditures for 1987 and the underlying assumptions.

- The survey sample size was not sufficient for an analysis of budget ratios by standard industry classification (SIC) codes.

- Respondents' budgets ranged from $100,000 to over $13 million, as shown in Exhibit I-3. Average budgets declined from 1.5% of shipments among small firms to 0.8% among very large firms, illustrating the economies of scale. Medium size firms (a group not targeted by most vendors) showed a broader range of responses.

EXHIBIT I-2

RATIO OF EDP BUDGET
TO ESTABLISHMENT SHIPMENTS

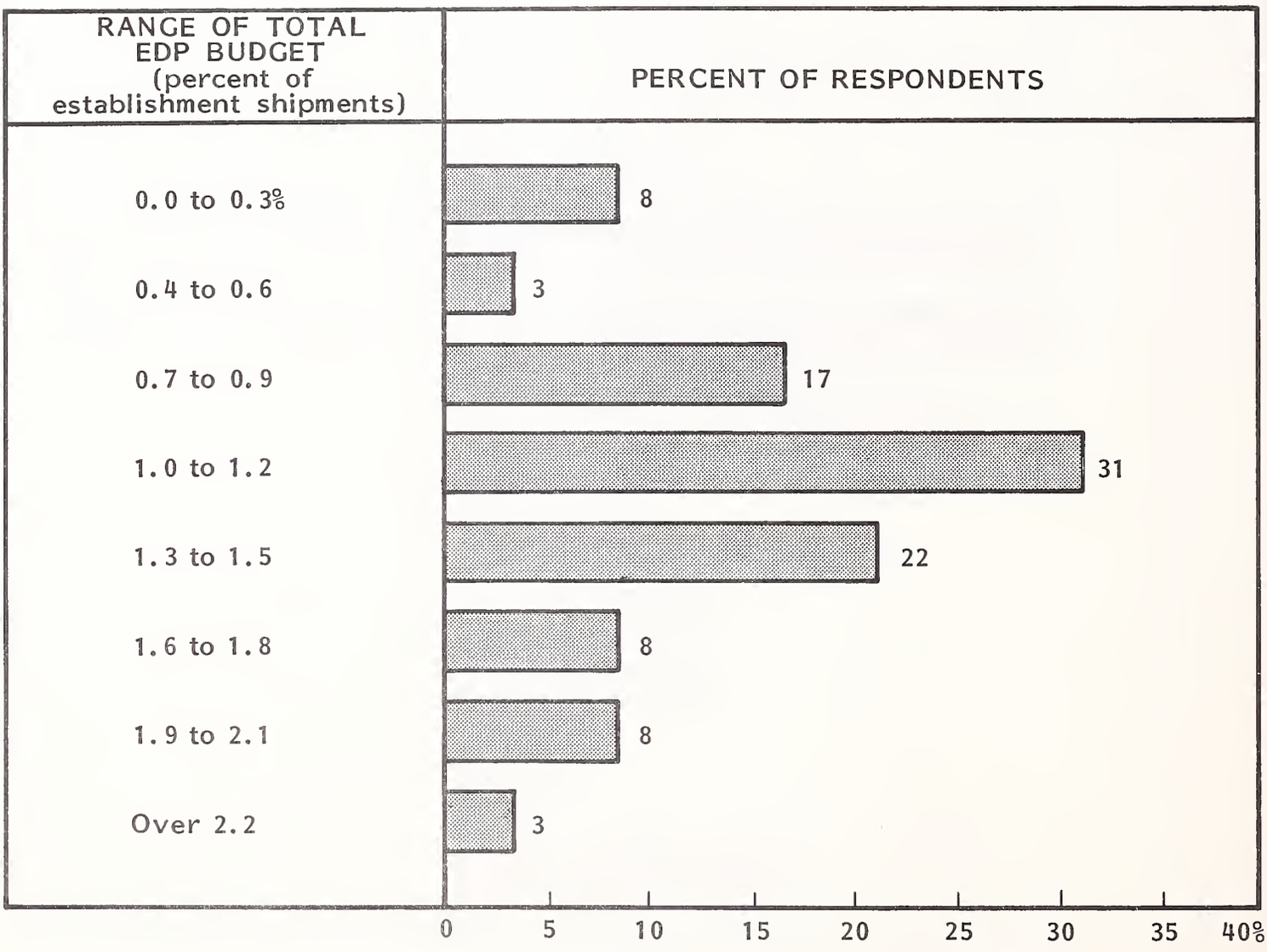


EXHIBIT I-3

RESPONDENTS' TOTAL DP BUDGETS

COMPANY OR ESTABLISHMENT ($ millions shipments)	TOTAL DP BUDGETS			
	($ thousands)		(percent of shipments)	
	AVERAGE	RESPONSE RANGE	AVERAGE	RESPONSE RANGE
Small (< $25)	$228	$100-400	1.5%	1.0-2.0%
Medium ($25-100)	940	500-3,000	1.5	0.6-4.0
Large ($100-250)	1,320	300-1,970	1.2	0.8-1.6
Very Large (> $250)	4,670	800-13,100	0.8	0.1-1.3
All Respondents	1,775	100-13,100	1.25	0.1-4.0

II EXECUTIVE SUMMARY

II EXECUTIVE SUMMARY

A. MARKET OVERVIEW

1. INDUSTRY PROFILE

- The discrete manufacturing industry, comprised of 11 industries as shown in Exhibit II-1, represents one of the largest industry segments in the U.S.

- The key industries in terms of numbers of employees, value added, and shipments are SIC 34 to 38.

- These industries are key because of their size and because of the complex processes used to manufacture their products.

  - These processes are generally resource-intensive, thus increasing management attention on acquiring computer aids to improve productivity.

  - The complexity of the processes requires extensive planning, scheduling, tracking, and accounting which are ideal tasks for computer solutions.

- Manufacturing firms were early users of computer aids and the need for improved systems and technology continues. The market is far from being

EXHIBIT II-1

DISCRETE MANUFACTURING INDUSTRIES - NUMBER OF ESTABLISHMENTS AND SHIPMENTS

SIC*	INDUSTRY	NUMBER OF ESTABLISHMENTS (thousands)	SHIPMENTS ($ millions)
23	Apparel & textile products	23	$43,030
25	Furniture & fixtures	9	21,065
27	Printing & publishing	44	62,665
30	Rubber & plastics products	12	46,850
31	Leather & leather products	3	9,005
34	Fabricated metal products	31	113,595
35	Machinery, except electrical	45	166,470
36	Electric & electronic equipment	13	116,030
37	Transportation equipment	9	201,625
38	Instruments & related products	7	37,740
39	Miscellaneous manufacturing	14	23,015
TOTAL		210	$841,090

* Standard Industrial Classification

saturated because firms need to upgrade computer systems to meet the serious challenges of improving productivity, meeting competition, and coping with severe economic conditions.

- The discrete manufacturing industry is made up of many firms, but the distribution is heavily skewed toward small establishments and is concentrated in specialized areas.

  - Eighty percent of the establishments have fewer than 50 employees.

  - Less than 2% of the total establishments have more than 500 employees.

  - SIC codes 34 through 38 account for 66% of total discrete manufacturing employees, 76% of shipments, and 74% of value added.

  - The largest 20% of the establishments within a SIC will account for 70% to 92% of the total output of that industry class.

- Although the industry can be readily segmented and identified, marketing it effectively is another matter.

  - Product needs vary widely across industries and even within an industry.

  - Each company has a different method of operation and usually insists on vendors' changing their products rather than the customer's changing his methods.

  - In many cases, the user is working with manual, incomplete, or obsolescent systems. The situation may be complicated by a lack of user sophistication and an inability to define his requirements.

- The companies in discrete manufacturing are in a difficult state as they attempt to modernize themselves, but there are rewards for the user and vendor who can work together to implement improved systems.

2. USER EXPENDITURES BY PRODUCT TYPE

- User expenditures for computer services in discrete manufacturing are forecast to grow at an annual compounded rate of 30%, from $4.0 billion in 1982 to $14.6 billion in 1987, as shown in Exhibit II-2.

- The highest growth rate is projected for software products due to several factors:

  - Continued unbundling by computer manufacturers.

  - Rapid growth in the number of new in-house systems and the resulting demand for applications packages.

  - Increasing requirements for data base-oriented systems and distributed data bases.

  - Expansion of systems to accommodate remote, on-line devices.

  - Development of complex, distributed, and integrated corporate systems.

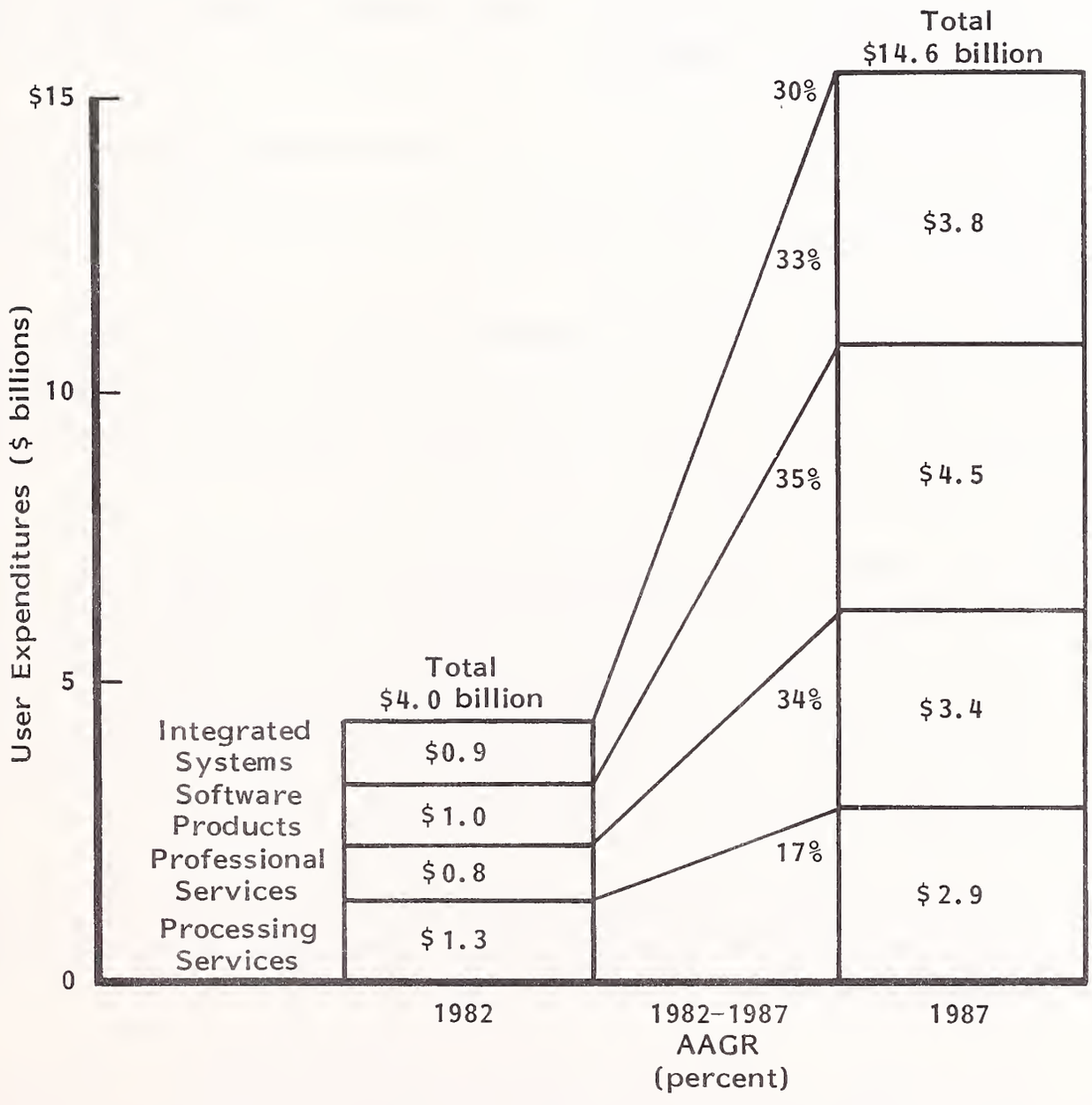
  - Decline in hardware prices.

- Most of the software expenditures will be for systems software rather than applications. The rapid proliferation of smaller systems and the distribution of system functions and data bases will help raise expenditures.

- The next highest projected growth area is professional services, at a 34% annual rate. The business function, the major user of professional services

EXHIBIT II-2

U.S. DISCRETE MANUFACTURING MARKET FORECAST,
1982-1987



today, will be surpassed by manufacturing by 1987. The driving factors here are the high degree of customization required in the software and systems and the chronic shortage of experienced systems people, especially those with a knowledge of manufacturing.

- Engineering will also require professional services support in the areas of computer-aided design (CAD) and computer-aided engineering (CAE). The latter is a rapidly growing field which promises greater productivity gains than any other engineering procedure.

- Integrated systems, forecast to be the largest expenditure class by 1987 ($4.6 billion), consist of complete hardware and software systems obtained from and installed by a single vendor.

- While integrated systems are available in virtually every application area, they are projected to be most prevalent in numerical control (NC), manufacturing production management, and CAD systems for design engineering and manufacturing engineering.

- Integrated systems are growing more popular with users because of their lower staffing requirements for software development, implementation, and support. Because technological advances have made hardware systems more cost effective and easier to implement, most major software vendors are now offering integrated systems. Conversely, hardware vendors are developing or acquiring applications to meet the users' desires for solutions.

- This is a new product expenditure class in the INPUT forecasts. It has been included because of its rapid growth and potential impact on the information systems industry.

- The last product area in the forecast is processing services. Processing services include batch processing, RCS, and processing FM. Although processing services is forecast to have the lowest growth rate in discrete manufactur-

ing, it is the largest segment in 1982 and still a large factor in the user expenditures, representing 19% of total expenditures in 1987.

- RCS is the largest delivery mode within processing services and represents 61% of processing services revenue in 1982 and 73% in 1987.

- The highest growth rates in RCS use will be in engineering modeling, analysis, and simulation. Manufacturing will continue to be a strong user of RCS, but growth will be slower as more applications are implemented on in-house systems. This trend to lower-cost, more powerful systems will be especially strong in the business area.

- Engineering is expected to be the organization responsible for driving the RCS growth as greater use is made of CAE, engineering analysis, and simulations. The manufacturing and business areas will decrease their usage of RCS.

- Batch processing services, which are now concentrated in the business areas of payroll and general accounting, will experience negative real growth as users find it more economical to take applications in-house. The in-house trend will be driven by less expensive, more powerful systems, and less customer fear of computers.

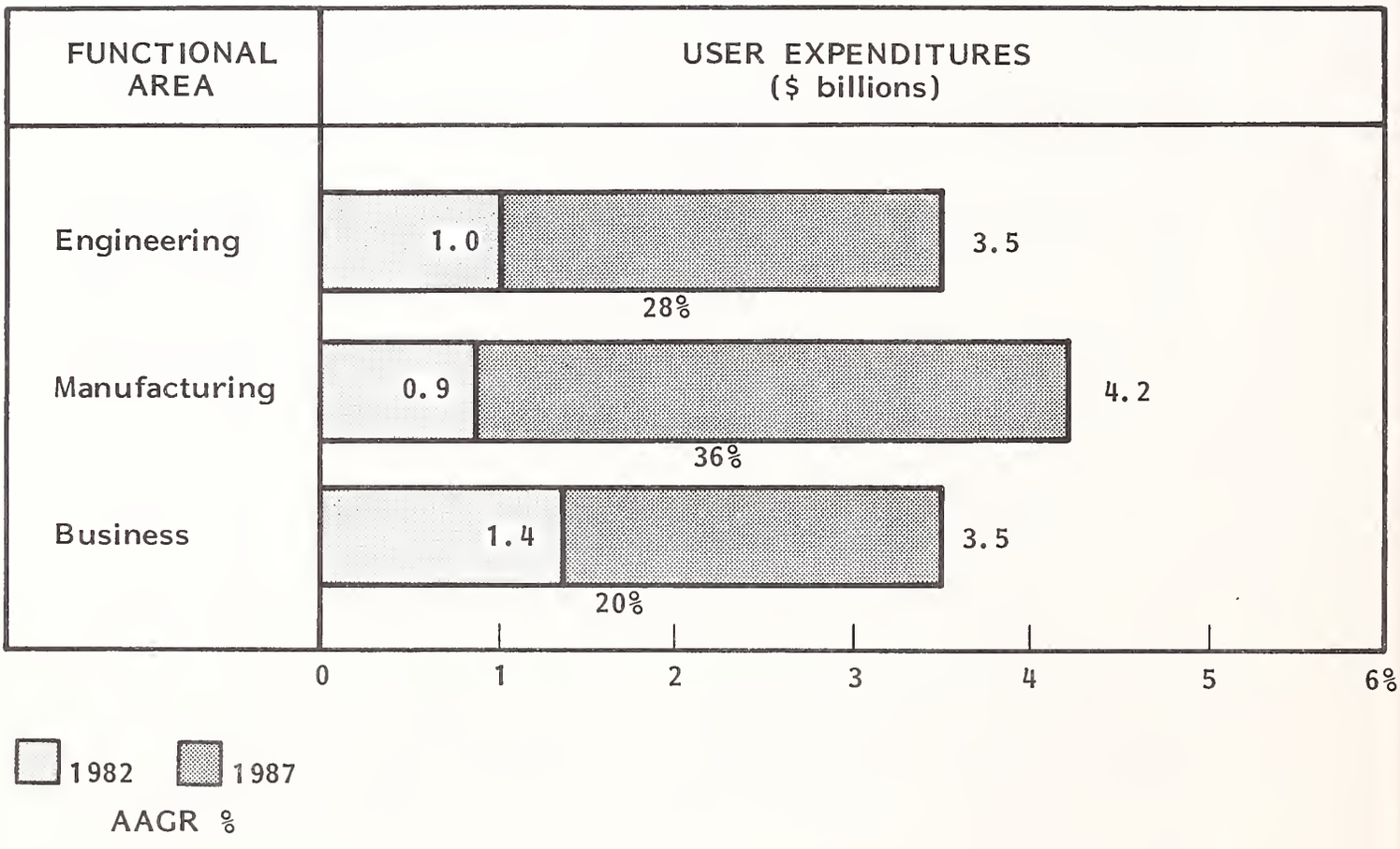
3. USER EXPENDITURES BY FUNCTIONAL AREA

- As shown in Exhibit II-3, the business area will experience the lowest growth over the next five years. This was the first area to be automated due mostly to standard accounting procedures and other business operations. Since no sweeping changes are anticipated in business operations and techniques, there will be a low level of product upgrade and replacement activity and overall relatively slow growth.

- User expenditures will grow most rapidly in manufacturing in response to intense internal and external pressures to improve operations efficiency.

EXHIBIT II-3

MARKET FORECASTS BY FUNCTIONAL AREA
(excludes systems software)



Production management systems will be the primary focus for improvement, followed by manufacturing engineering.

- The manufacturing area will grow rapidly in expenditures for professional services. Computer systems expertise in the manufacturing organization will not keep pace with the new systems implementation activities necessary for increased productivity.

- Integrated systems for both production management and manufacturing engineering will show significant growth in manufacturing, as will applications software. Processing services will grow more slowly as more applications are taken in-house.

- Although engineering shows significant growth in all product expenditure areas, it is forecast to fall behind manufacturing by 1987 in total expenditures. The engineering area will continue to spend for integrated systems for CAD and CAE.

- Growth rates for engineering expenditures on professional services are over 40% per year and applications software growth will approach 40% per year. CAE techniques will be the primary driving force in both product expenditure areas.

B. RECOMMENDATIONS

- Discrete manufacturing will continue to be a sound market with excellent growth. It is also a fragmented and diverse market and as such, very complex for vendors to serve.

- INPUT recommends that new vendors entering this market or vendors who are currently in it should take a hard look at their capabilities to adequately serve the market segments they have targeted:

- Many vendors are burdened with support and custom modification obligations because they have failed to carefully select and focus on optimum market segments and to meet the criteria for acceptable or profitable business.

- Market segments selected in the past may no longer be appropriate for reasons such as product obsolescence, increased user knowledge and sophistication, new methods and techniques, changes in cost effectiveness due to new technologies, organizational changes, and even governmental or economic factors at the national level.

- The market is becoming very cautious, expecially in the production management area, because of unfulfilled vendor promises over the years. Vendors have overcommitted both product capabilities and their support people.

- Both users and vendors cite poor communications as a major problem. The users mention groups such as manufacturing and DP, while the vendors complain about the users' ability to adequately define their needs.

  - Vendors must make an effort to understand the end user's application and requirements, and then communicate at his level in his terms.

  - Vendors must also recognize the communications problems among user organizations, and prevent those problems from hindering their efforts. For example, if DP and manufacturing are not communicating, and DP is procuring a product for manufacturing's use, the vendor could face problems later because of unanticipated or misunderstood requirements.

  - Means for improving communications with the marketplace should be considered, including customer satisfaction surveys, user groups, newsletters, informative advertising, and active participation in professional societies. Vendor personnel at all levels must visit user sites to obtain a first-hand appreciation of users' perspective and the state of affairs

in the real world. Managers must also insure that their people are working with all user organizations who will be involved in the implementation and ongoing use of their products.

- Vendors should consider higher levels of specialization to attain higher sales close rates, more efficient use of resources, better understanding of the market segment they serve, and a better reputation in the industry. Higher specialization will also be required as users become more experienced and hence more demanding of the vendors.

- Traditional vendor strategies have been to pursue only the large firms because they are the most visible. They also are the most sophisticated and the most demanding, with the most difficult unique requirements.

- Vendors should investigate smaller establishments and tailor products and services to that environment. Small to medium firms represent a large and virtually untapped market.

  - They are becoming better-educated about technology and more accustomed to capital expenditures for high-technology equipment such as NC machine tools or CAD systems.

  - Although their needs are not so well-defined as the larger users' needs, they do not have such strong predispositions as larger users do.

  - Vendors will be required to place more emphasis on product packaging, installation, and education to minimize support exposures.

- While the larger market size of small establishments may be attractive to some vendors and uninteresting to others, company size alone is not an adequate measure of market potential.

  - Many vendors have a single dimension perspective of the market, the dimension being establishment shipments.

- Other factors should be considered to determine if a limited perspective is causing a vendor to overlook a profitable market niche. Vendors must segment their markets by a number of criteria. Market directions must not be based on simplistic assumptions and analyses.

- Some of the other factors are type of products manufactured, complexity of products, level of value added, and use of other high-technology systems or products.

- Because the shortage of skilled user staff will worsen in the future, vendors will have to educate, train, and assist the users. While vendors will find it competitively necessary to respond to these demands, they should also recognize a revenue opportunity. Providing professional services along with other products yields not only incremental revenue, but also more control over the user's activities.

- The continuing improvement in hardware price/performance threatens RCS vendors by making local high computing capacity more affordable. RCS vendors can benefit from this trend only if they offer unique or true added value products and target their offerings at user weaknesses. For example, integrated CAD systems cannot support computer-intensive tasks such as solids modeling, very large-scale integration circuit simulations or complex printed circuit board placement and routing.

- All vendors must continually evaluate their products relative to the integration issue. There is a definite trend toward application and systems integration. This situation could impact vendors in every functional and application area. Vendors should work with users who are advanced in their integration development to better understand this problem and to develop prototype products. Although this will take scarce resources initially, it will be a good investment in the long run.

- Vendors must also carefully monitor the technological trends in hardware because changes in system structures could impact their products. For

example, CAD system vendors have been surprised by the rapid evolution of workstations into full-function, standalone systems. Rapid changes in technology make vendor complacency fatal.

- Although very small systems or personal computers are no immediate threat to most vendors, because of their relatively limited use, this situation bears watching. The concern is not a direct impact in the near term, but a possible delay in other procurements because user requirements are partially satisfied. Purchase of these small systems also means a diversion of funds.

III MARKET ANALYSIS

III MARKET ANALYSIS

A. OVERVIEW

- The total manufacturing industry is divided into two subdivisions: discrete manufacturing and process manufacturing.

  - Discrete manufacturing is characterized by the fabrication and assembly of discrete components which are typically sold as units. The manufacturing process involves extensive physical transformation of the raw materials. The end products do not require further processing.

  - Process manufacturing is characterized by the transformation of raw materials on a continuous or flow process where the finished products represent raw materials for input into other processes or finished products which are sold by measure; i.e., the pound, yard, or quart.

- The discrete manufacturing sector is comprised of the eleven industries shown in Exhibit III-1.

- Discrete manufacturing represents one of the largest industry segments in the U.S.

  - It includes approximately 5% of total U.S. business establishments and 18% of total U.S. business employment.

EXHIBIT III-1

DISCRETE MANUFACTURING INDUSTRIES -
NUMBER OF ESTABLISHMENTS AND EMPLOYMENT
(thousands)

SIC*	INDUSTRY	NUMBER OF ESTABLISHMENTS	TOTAL EMPLOYEES
23	Apparel & textile products	23	1,333
25	Furniture & fixtures	9	507
27	Printing & publishing	44	1,252
30	Rubber & plastics products	12	809
31	Leather & leather products	3	238
34	Fabricated metal products	31	1,720
35	Machinery, except electrical	45	2,457
36	Electric & electronic equipment	13	1,961
37	Transportation equipment	9	1,996
38	Instruments & related products	7	630
39	Miscellaneous manufacturing	14	455
TOTAL		210	13,358

* Standard Industrial Classification

- In terms of U.S. employment, it ranks fourth behind wholesale/retail, government, and services.

- The discrete sector includes approximately 13 million employees in 209,000 establishments. An establishment is defined as a single physical location at which business or industrial operations are conducted.

- Discrete manufacturing is a key industry sector for vendors of computing products and services for several reasons:

  - The transformation processes are usually complex, requiring extensive scheduling, tracking, and record keeping.

  - The labor content of manufactured goods is high in relation to the total value of the end product and thus must be carefully managed.

  - In-process and finished goods have high relative values and require accurate accounting.

  - Adequate returns on investment depend on the optimum use of functionally independent machines or work cells.

- Firms in this sector have been placed in a difficult position by the world economic situation in recent years.

  - Since they generally do not produce basic-needs goods such as food and shelter, their businesses are the first to feel the impacts of a tight economy and some of the last to benefit from a recovery.

  - Rapidly rising costs of labor, materials, energy, and capital are straining manufacturers financially.

  - For many, the only solution to this dilemma is to increase their investment in management tools such as computer aids.

B. INDUSTRY STRUCTURE

- The purpose of this section is to give the reader statistical information to understand the discrete manufacturing industry. This industry has a very complex structure because of the diversity in the size of establishments, the distribution of establishment sizes, the types of products manufactured, and the manufacturing processes employed.

- Vendors should periodically review the structure of the industry and reevaluate their products or services to determine whether they fit the industry segments they are pursuing.

- Exhibit III-2 shows the most common indicators of the industry's structure, employees and shipments. However, to better define the industry, value added shipments and value added per employee have been added to the exhibit.

  - Value added is important because it represents over 50% of total shipment value for discrete manufacturing, and it is a good indicator of the complexity of the manufacturing process within an industry segment.

  - A high value added per employee tends to indicate a more complex manufacturing process, one which is more labor-intensive or one which involves more highly paid personnel.

  - High value added industries are generally more sensitive to the needs for tight scheduling of the manufacturing process, close determination of standard costs, and accurate tracking of and accounting for labor.

  - Industries with a high value of shipments per employee tend to be more sensitive to the control of materials and are very concerned with procurement, raw materials inventory, work in process, and finished goods inventories.

EXHIBIT III-2

DISCRETE MANUFACTURING - INDUSTRY SHIPMENTS AND VALUE ADDED

SIC*	INDUSTRY	EMPLOYEES (thousands)	SHIPMENTS ($ millions)	SHIPMENTS PER EMPLOYEE ($ thousands)	VALUE ADDED ($ millions)	VALUE ADDED PER EMPLOYEE ($ thousands)
23	Apparel	1,333	$43,030	$32	$21,710	$16
25	Furniture	507	21,065	42	11,000	22
27	Printing/ publishing	1,252	62,665	50	40,305	32
30	Rubber & plastics	809	46,850	58	23,110	29
31	Leather products	238	9,005	38	4,250	18
34	Fabricated metal	1,720	113,595	66	56,895	33
35	Machinery	2,457	166,470	68	92,530	38
36	Electric & electronic	1,961	116,030	59	66,475	34
37	Transportation	1,996	201,625	101	80,950	41
38	Instruments	630	37,740	60	24,600	39
39	Miscellaneous	455	23,015	51	11,935	26
	TOTAL	13,358	$841,090	$63	$433,760	$33

* Standard Industrial Classification

- All industries within discrete manufacturing are ranked in Exhibit III-3 to illustrate leading industries by various criteria.

- SICs 34 through 38, including at least four of the top five industries in every ranking category, are the key industries for computer services within discrete manufacturing. As shown in Exhibit III-4, they represent the bulk of total discrete manufacturing shipments and value added. They also include approximately 50% of all establishments.

- INPUT estimates that this group of industries represents over 90% of the information services expenditures for the total discrete manufacturing industry.

- There are important subsectors within each of the key industries. Statistics relating to the 10 largest subsectors have been determined and are shown in Appendix B, Exhibits B-1 and B-2.

- Another important factor for vendors to consider when analyzing the structure of the industry is its distribution of either companies or establishments.

- INPUT believes that establishments are a preferred method of defining the industry.

  - Plant sites of larger companies typically must be addressed as individual entities during the sales cycle.

  - Product installations and ongoing support are usually conducted at the establishment level regardless of the level where the order was signed.

  - Market analysis and planning based on establishments represent a worst-case situation which is usually preferable as a conservative planning case.

EXHIBIT III-3

INDUSTRY RANKINGS BY VARIOUS CATEGORIES

SIC*	INDUSTRY	EMPLOYEES	SHIPMENTS	SHIPMENTS PER EMPLOYEE	VALUE ADDED	VALUE ADDED PER EMPLOYEE
23	Apparel	5	7	11	8	11
25	Furniture	9	10	9	10	9
27	Printing/publishing	6	5	8	5	6
30	Rubber	7	6	6	7	7
31	Leather	11	11	10	11	10
34	Fabricated metal	4	4	3	4	5
35	Machinery	1	2	2	1	3
36	Electrical	3	3	5	3	4
37	Transportation	2	1	1	2	1
38	Instruments	8	8	4	6	2
39	Miscellaneous	10	9	7	9	8

* Standard Industrial Classification

1 = Highest Ranking
11 = Lowest Ranking

EXHIBIT III-4

KEY DISCRETE MANUFACTURING INDUSTRY STATISTICS

SIC	INDUSTRY	EMPLOYEES*	SHIPMENTS*	VALUE ADDED*
34	Fabricated metal	12.9%	13.5%	13.1%
35	Machinery	18.4	19.8	21.3
36	Electrical/electronics	14.7	13.8	15.3
37	Transportation	14.9	24.0	18.7
38	Instruments	4.7	4.5	5.7
TOTAL		65.6%	75.6%	74.1%

*Percent of total discrete manufacturing industry

- Detailed statistics on the distribution of establishments by employee size class, shipments, and value added are in Appendix B, Data Base, Exhibits B-3 through B-5.

- The size distribution of discrete manufacturing is heavily skewed toward small establishments:

  - Approximately 80% of the establishments have fewer than 50 employees.

  - Less than 2% of the total establishments have fewer than 500 employees.

  - Machinery, electrical/electronics, and transportation are the only SICs with more than 50 establishments of over 2,500 employees.

- Ninety-eight percent of the total industry shipments and value added is produced by small firms (under $25 million in shipments and $15 million in value added). Vendors addressing the electric/electronic and transportation industries will find a more favorable distribution with only 93% and 89% respectively of small establishments.

- Even though a small number of establishments fall into the larger size classes, they produce the greatest share of the output. For example, the largest 10% of the transportation establishments produce 85% of that industry's output while the top 20% produce 92%.

- The distribution of output among the largest establishments for each SIC is shown in Appendix B, Exhibit B-6.

C. INDUSTRY STATUS AND DIRECTIONS

- An overview of manufacturing functions is shown in a simplified form in Exhibit III-5. Some of the key activities and outputs are shown for each function. This exhibit illustrates a product manufacturing flow for companies producing a complete product as opposed to component manufacturers or job shops.

  - The job shop process is much simpler because the contractor determines the component design, the lot size, and other requirements.

  - Typically, job shops do not require sophisticated techniques such as master production scheduling and material requirements planning (MRP) or extensive inventory accounting and analysis. They are, however, very sensitive to capacity planning and shop floor control.

- The manufacturing process is, in theory, a continuous flow of operations. In reality, it is a stop-and-start series of emergencies and expedited actions.

  - The average machined part spends 95% of its time in the factory waiting or being moved and only 5% of its time on a machine.

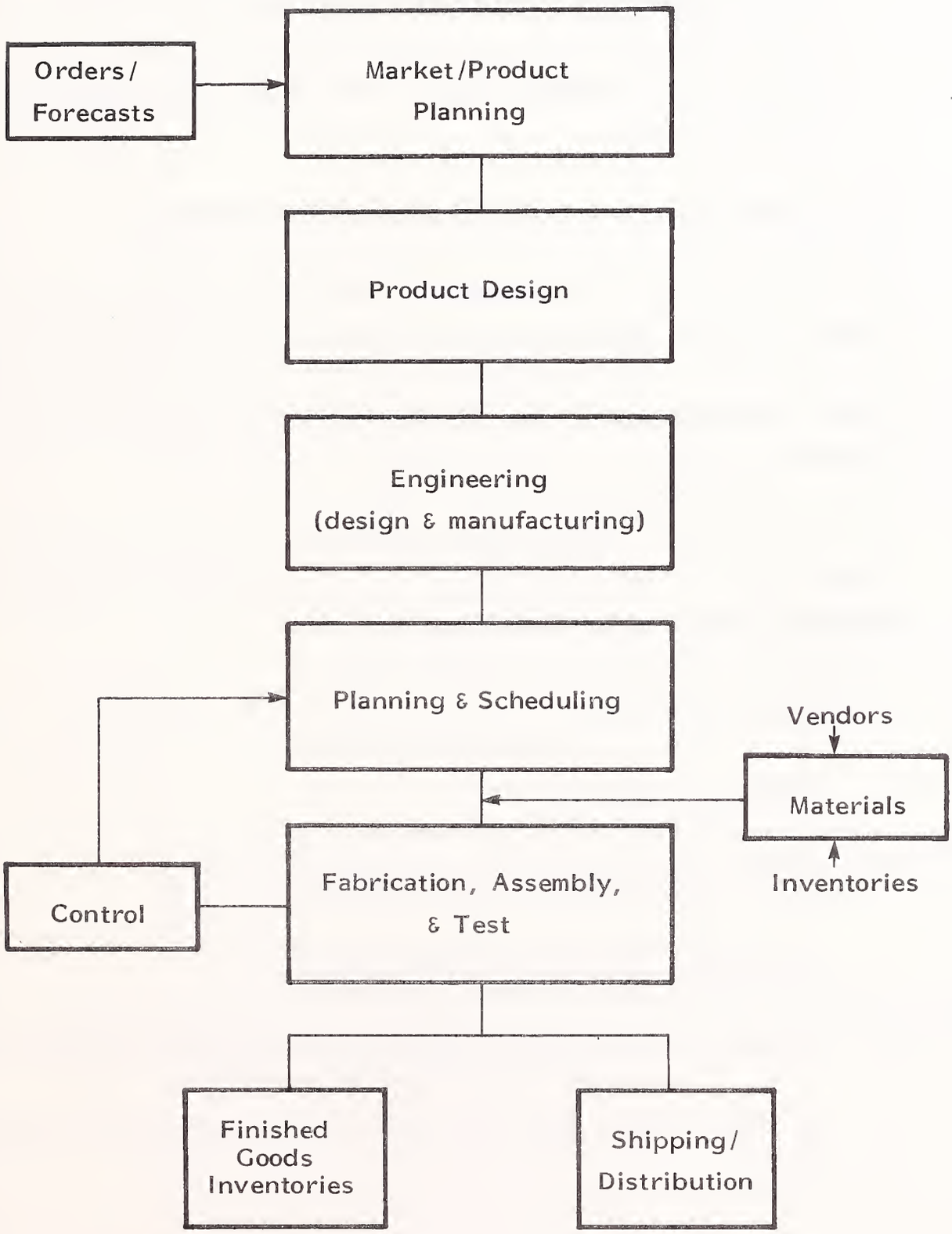
  - Electronics components fare little better, with moving/waiting time estimated as high as 80%.

  - Some companies complete as much as 75% of their monthly shipments in the last five days of the month due primarily to stock shortages and schedule interruptions.

  - Computer aids are coming into play, but the most common solutions to the problem are still expediters and overtime. Only a small percentage of manufacturing plants are operating without expediters' shortage lists.

EXHIBIT III-5

DISCRETE MANUFACTURING PROCESS



- Scheduling manpower and machines and managing inventories for even a small number of products within a plant can be complex and challenging tasks, but extremely important ones.

  - Materials accounted for from 36% to 62% or an average of 48% of shipments for discrete manufacturers in 1979.

  - Labor represented approximately 25% of shipments, ranging from 19% to 27%.

  - End-of-year inventory values averaged 16% of shipments.

- The detailed expenditure percentages are shown in Appendix B, Exhibit B-7. These expenditures show the sensitivity of the various industries to the costs of materials, labor, and inventories. They can be used by vendors to select target markets by overlaying product capabilities and selecting the areas of greatest need/benefit.

- Materials and labor combined amount to 73% of the value of shipments in the average discrete manufacturing firm. The remaining 28% of revenue from shipments is being stretched very thin by:

  - High interest rates.

  - Escalating energy costs.

  - Higher inventories due to depressed demand.

  - Government regulatory compliance programs.

  - Equipment upgrades and increased R&D to meet competitive pressures.

  - Effectively higher labor costs due to declining productivity growth rates.

- Long-term forecasts for manufacturing predict fully integrated computer-based systems, computer-controlled factories, heavy use of computer-aided process planning and group technology, computer-controlled robots and other machines, the paperless factory, and other high-technology innovations.

- All of these elements are in use today in one form or another in the leading edge companies; however, it will be many years before the average manufacturer has fully realized the benefits available from the products on the market today:

  - Of an estimated 50,000 full or product manufacturing companies (as opposed to job shops), less than 10% have MRP systems, and perhaps 20% of the MRP users use their systems for more than inventory control.

  - Group technology (classification and coding) systems and computer-aided process planning are only being used in a small number of very large companies even though they offer tremendous cost reduction benefits.

  - Production management systems have a poor reputation due to overselling on the part of the vendors and insufficient commitments by the users. This factor, as well as the current economic conditions, makes potential users proceed cautiously.

  - The economic environment of high interest rates and low corporate earnings is having a slowing effect on the installation of new systems and upgrades.

- The most realistic scenario for the use of computer aids in discrete manufacturing will consist of a progressively greater use of systems in all applications and functional areas and by smaller companies.

- Companies who are underutilizing the management systems they have installed today will be forced by economic and competitive pressures to make optimum use of these systems.

- Integration of systems such as CAD/CAM will be emphasized, but more importantly applications will be integrated through data base management systems (DBMS). Many user systems today are not integrated even within an application area such as finance or manufacturing, much less at a higher level where finance and manufacturing applications could share a common data base.

- Systems will be made available for more small companies than are being addressed by vendors today for two reasons:

  . Lower cost hardware will make small systems more affordable.

  . Competitive pressures will force more vendors to address smaller users.

- RCS and software product vendors should capitalize on the opportunity by developing products which address the need.

- The discrete manufacturing industry will continue to decline in total employment and be near zero growth rate in total output (in real terms) through the foreseeable future. But this industry will continue to be one of the largest and fastest-growing markets for computer-related products and services into the late 1980s.

  - The nature of this manufacturing process allows discrete manufacturing to be one of the most highly automated and computer-assisted industries.

- Discrete manufacturing was the first industry to apply computer-assisted techniques to the creative process of design, and will continue to be leaders in the use of computers.

D. MARKET OPPORTUNITIES

1. DYNAMIC ENVIRONMENT IMPACTS COMPUTER SERVICES VENDORS

- Exhibit III-6 shows some representative applications or functions for each major operation in the manufacturing process. These operations will be discussed to show key opportunities and trends in manufacturing in general.

- Even though the discrete manufacturing market has been affected by the sluggish economy, there are still sound opportunities for information services vendors. The challenge is to stay on top of the market, constantly analyzing it, assessing product positions, and testing the validity of market strategies and plans.

- Conditions are constantly changing in manufacturing due to a number of factors such as foreign competition, the economy, changing social forces, new technologies, and government regulations.

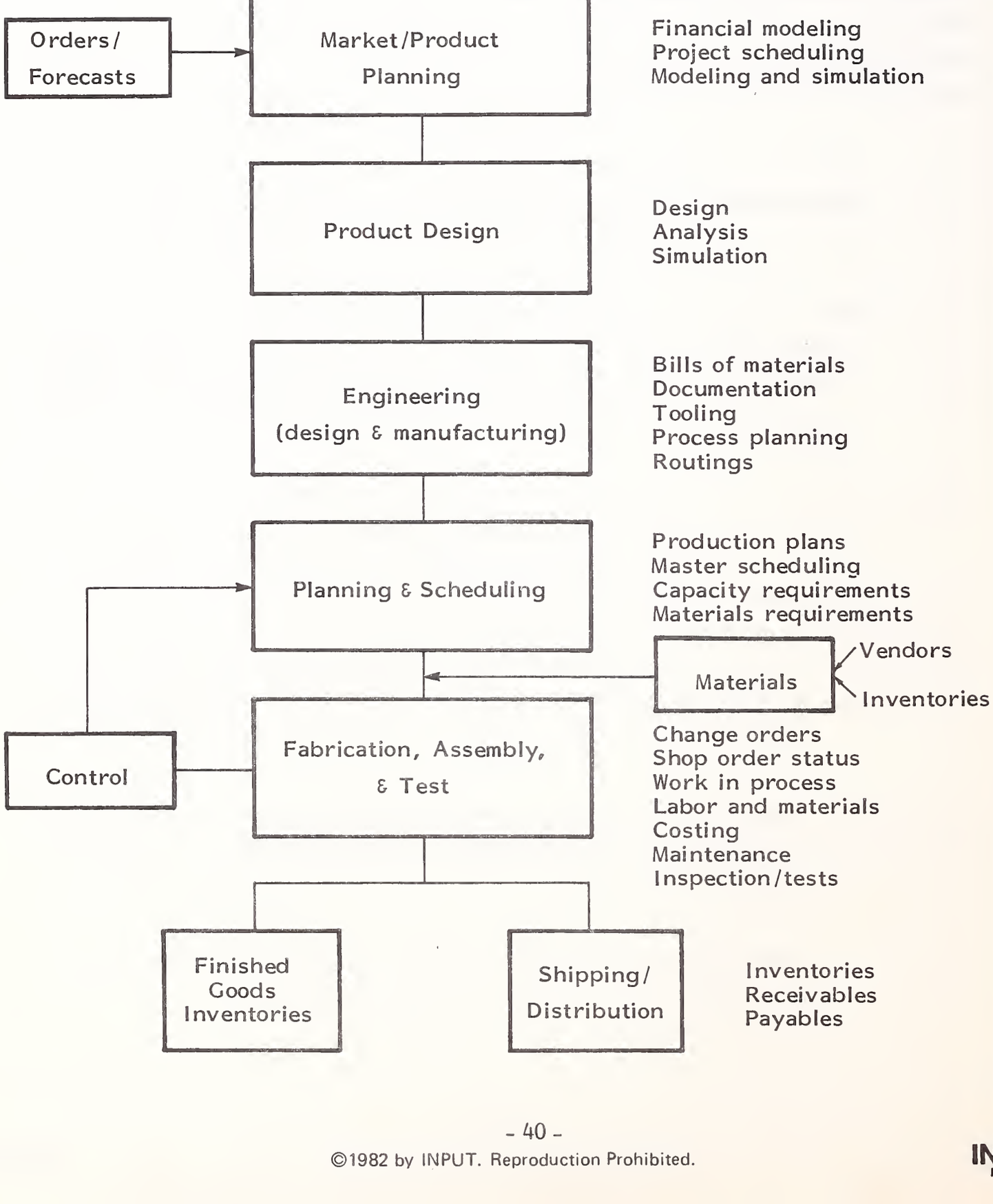
  - For example, higher oil prices, foreign competition, and government regulations forced the automotive companies to invest in massive engineering and retooling programs.

  - Even though automotive industry revenue is down dramatically, companies are finding it necessary to invest in computer aids such as CAD and CAE to survive.

  - Vendors must anticipate these shifts in all industry segments and adjust their product and marketing strategies accordingly.

EXHIBIT III-6

DISCRETE MANUFACTURING PROCESS



- As larger users restrict or redirect their spending, some vendors will be forced to turn to smaller or new market segments. Users are also shifting purchases to smaller systems and less sophisticated packages to limit expenditures and lessen the impact on their already strained resources.

- One action that merits investigation by vendors is relaxing their requirements on target customer size. While more problems may result from selling to and supporting smaller-sized establishments, the move may be worth it considering the exponential increase in potential market size.

- Vendors must also consider narrowing their market focus. Most vendors interviewed had very broad criteria for their target markets. Increased competition and growing user sophistication both require vendor specialization.

- The manufacturing market is changing rapidly in a number of application areas due to wider acceptance of computer aids, pressures to improve productivity, advances in computer-aided technologies and techniques, and rapid improvement in cost/performance ratios. Some of the areas of change in the functions shown in Exhibit III-6 are discussed in the following sections.

2. MARKET AND PRODUCT PLANNING

- This has formerly been a province of only the very large user companies. Smaller companies are now discovering the advantages of modeling and forecasting tools. Project scheduling and project planning and control packages are also being used more extensively to better control labor costs and insure on-time completions.

- Large companies also access econometric and other specialized data bases. While large companies will have the resources to run such applications internally, this is an RCS situation for most smaller companies.

- Companies are paying more attention to sales forecasting systems today because of the increased impact of costs on their weakened financial positions. Companies who manufacture for inventory must avoid the materials, labor, and carrying costs of overproducing, and the cost inefficiencies and schedule disruptions of additional, small-lot production runs in the case of underproducing.

- The wider use of more sophisticated production management systems will make the manufacturing process more efficient because of better management controls. This, in turn, will place more emphasis on planning, simulation, and forecasting to optimize the use of resources.

- The market/product planning area will not be a large source of vendor revenue in general, but can be a viable market for highly specialized vendors.

- INPUT recommends that RCS vendors concentrate more of their efforts in this application area.

3. PRODUCT DESIGN AND ENGINEERING

- Advances in interactive, graphics-based CAD systems are causing rapid and dramatic change in product design and engineering.

- The preferred CAD product type is an integrated system, but the rapid growth in CAD systems is also creating other opportunities for vendors.

  - CAD systems not only make the design and drafting processes much more efficient, but they also facilitate analyses and simulations by removing many of the laborious data entry and manipulation stages.

  - CAD systems have also shown managers the benefits of computer aids. As a result, managers are eager to continue and even increase their investments in all types of information services.

- Continued developments in design and engineering techniques will result in strong expenditures for integrated CAD systems, analysis and simulation software and services, process planning software, group technology software, and numerical control programming systems, software, and services.

- Design and engineering, a highly specialized area requiring a high level of vendor technical competence, can be the most accommodating to vendors because users are usually more flexible in these applications and will tend to use more standard packages with no customizing.

- Analysis and simulation tasks are good targets for RCS vendors because users typically do not have adequate capacity on their integrated or in-house systems. The vendors must find ways to facilitate the transfers of data with integrated systems, however.

- The manufacturing organization is becoming a very active user of CAD systems, primarily for NC programming and tooling design. It will be the fastest-growing user over the next five years.

- CAD systems productivity gains result not only from the automation of design and drafting tasks, but also from the ability to capture important product data at its source and make it readily available to other applications and functions such as bills of materials (BOM), process planning, and documentation. Vendors should analyze the impact of CAD systems on their products and offer interfaces to take advantage of this rapid market growth.

  - RCS vendors can play an important role in data gathering and distribution to various other functional areas within manufacturing companies.

  - Software vendors must be prepared to offer more fully integrated systems.

4. PLANNING AND SCHEDULING

- User flexibility is limited in the planning and scheduling area and vendors face numerous requirements unique to a particular customer. Each customer wants his software or system to conform to the procedures and methods he has developed over time.

  - These requirements are often less efficient than the standard package approach, but the user may not have an adequate appreciation of computer technology to realize it.

  - Unfortunately, the vendor often does not understand the application well enough and he engages in a standoff with the user, who usually wins.

- There is a large market for software and integrated systems in the more sophisticated applications of MRP, capacity requirements planning, and master production scheduling.

  - There are over 150 companies offering MRP systems today, but the difficulty of full implementation and problems with the products and the vendors' support have made the success rate low.

  - The market is becoming more aware of the advantages of these systems, but successful sales and installations will require heavy vendor support for education, training, customizing, and ongoing support.

  - This represents a major opportunity for professional services vendors due to the shortage of resources and computing expertise in the average manufacturing organization.

  - Software and processing services vendors should develop a professional services capability as an additional revenue stream which will also support the sale of their current products and services.

- Intensive education by vendors and professional societies may help users understand the systems better and reduce their customizing requirements, but the most probable motivation will be need. As users become more pressed to implement productivity aids, they will become more reasonable and the market will accelerate rapidly.

- User education is important, but vendors must also improve their knowledge of manufacturing production management techniques if they are to succeed in this application area. Virtually every user and every industry subsector has its own requirements, and a vendor must be solidly versed in manufacturing to communicate with the users.

5. FABRICATION, ASSEMBLY, AND TEST

- This area has not received as much publicity as some of the other applications, such as MRP, but there are significant opportunities here, especially in shop floor control.

- The movement of materials and utilization of resources according to schedule are critical to a manufacturing company. Materials represent up to 62% of manufacturing expenditures, and labor as much as 27%. Clearly, a vendor who can demonstrate systems providing a faster flow of materials through a plant at reduced labor will succeed in this market.

- Shop floor systems represent a large market for integrated systems and some software. The systems will be highly individualized and must tie into other systems, so customizing and professional services will come into play. Vendors should look to developing application generators to meet these requirements.

- Testing could be a large opportunity, but it is not well-defined at present. More effort is being focused on this area, but it is not as significant a problem as production management, except in the electronics industry.

6. INVENTORIES

- Inventories of finished goods, raw materials, or work in process are important to the planning, control, and financial functions.

- Finished goods and raw materials inventories are well-developed applications in most companies and do not represent an area of high growth for vendors.

- Work in process accounting is not so well-developed because it depends on a sound job or work order tracking system. This area has potential for vendors, but it is another one with a high degree of individual user requirements. Also, the vendor must know the process and techniques well because he must lead the user in the development of successful systems.

  - Again, industry and application knowledge are vital for vendors to succeed.

  - Vendors must develop internal specialists to take advantage of the opportunities.

7. SHIPPING AND DISTRIBUTION

- Shipping and distribution systems are only used by discrete manufacturing companies who make products for inventory or in large quantities.

- This limited market does not represent a significant segment for new vendors.

8. BUSINESS APPLICATIONS

- The business area includes all accounting and finance applications, sales and marketing, personnel, payroll, and other human resources applications.

- Even though it is a heavily saturated area with many mature applications, it still represents a sound market for systems software, professional services, and applications software.

- Business applications per se have not changed much over the years, but their method of implementation is changing. Many users are replacing their discrete financial applications with integrated systems which usually communicate through a data base.

- This area is usually responsible for the corporate data center, so it can be involved in information services procurements across several areas.

- Vendors should work with users toward developing comprehensive decision support systems (DSS), especially in the financial area. In some companies, marketing may be a more fruitful area for DSS.

E. MARKET PARTICIPANTS

- The profile of vendors serving discrete manufacturing resembles that of the manufacturing industry in many ways:

  - There are several hundred firms offering products on a national basis. The distribution of vendor size is heavily skewed toward the small companies.

  - A large number of products, product options, product combinations, and delivery modes are available.

  - Very little standardization exists.

- The market is highly fragmented among the vendors; that is, there is no one vendor who controls the market and whose name is considered by the users to be synonymous with manufacturing.

- IBM has a very strong presence, with the largest overall market share, but it is not immune from the difficulties of implementing successful production management systems, and it still has a long way to go to be considered the leader in manufacturing.

- The computer manufacturers are becoming active in applications selling, with most of their efforts in the less support-intensive and more standardized product areas of engineering and CAD.

- IBM and Univac appear to be the most committed of the computer manufacturers to this market. Although other mainframe companies have production management systems, and they and the smaller vendors now offer a variety of engineering and CAD systems, they are not adding the resources as intensively as IBM and Univac.

- IBM has offered production management systems such as PICS, COPICS, and MAPICS for some time, but has been aggressively rounding out its capabilities within recent years.

  - It is in a strong number two spot in the CAD market and could have the largest share within two years.

  - It has added a number of products to its base package, Lockheed's CADAM, and is rumored to be working internally on additional complements to it.

  - In February, it announced two industrial robots and an accompanying programming and control language.

- Univac established a dedicated manufacturing organizaiton approximately five years ago. This organization has focused primarily on its UNIS system for manufacturing planning and control.

  - Apparently, this approach has been very successful and INPUT estimates that the manufacturing industry organization will account for 40% of Sperry Univac revenue in 1982.

  - In June 1982, Univac announced a large-scale CAD/CAM system for mechanical applications. This system has some very advanced capabilities including solids modeling and integration with the data management systems.

- Digital Equipment Corporation (DEC) is investing considerable energy and resources in its Engineering System Group, which has the responsibility for further penetration of the manufacturing market. DEC has long been a leader in selling hardware into the engineering and manufacturing organizations of discrete manufacturers. It is now aggressively pursuing an applications-based strategy utilizing a broad repertoire of third-party software.

- Hewlett-Packard also uses a third-party software reference service to approach manufacturers on an applications basis, but it does not appear to be as aggressive as DEC. It definitely is being outpaced by DEC in the CAD area.

- Software product developers should pursue distribution and/or licensing arrangements with computer manufacturers to increase their marketing capability toward the manufacturing sector.

- Professional services firms with expertise in manufacturing applications should look for joint venture or distribution arrangements as a means of entering the software market in this sector.

- Exhibit III-7 shows INPUT's estimates of the leading vendors' revenue from discrete manufacturing only. Computer vendors have not been included in the application software and integrated systems lists so that the top independent companies' rankings could be clearly shown.

- RCS includes a variety of vendors and functional areas:

  - GEISCO's revenue mix is estimated to be 20% function-specific (business-oriented) and 80% industry-specific of which 75% is manufacturing and 25% is engineering.

  - Xerox Computer Services (XCS) earns 40% of its discrete manufacturing revenue from business and 60% from manufacturing. XCS appears to be undergoing both market and internal problems and could begin to lose its market share.

  - While Control Data Corporation (CDC) is the leading RCS vendor overall, its revenue in this industry puts it in the number three spot. Approximately 65% of the revenue shown comes from the engineering area with the remainder from the business area.

  - Manufacturing Data Systems Inc. (MDSI) is a highly specialized vendor and realizes all of its RCS revenue from NC programming and machine tool tape preparation. It is the clear leader in this industry specialty.

- Only two vendors are shown for batch services - CSC's Service Bureau Company (SBC) and Automatic Data Processing (ADP). Beyond these two companies, there are no significant vendors operating on a national basis. This market segment is heavily populated with small, local firms.

- CDC, with its Cybernet and SBC subsidiaries, is the largest processing services vendor to the discrete manufacturing industry sector.

EXHIBIT III-7

LEADING VENDORS' 1982 ESTIMATED
DISCRETE MANUFACTURING REVENUE

INDUSTRY APPLICATION	VENDOR	1982 ESTIMATED MANUFACTURING REVENUES ($ millions)
RCS	General Electric Information Services	$65
	Xerox Computer Services	56
	Control Data Cybernet	47
	Manufacturing Data Systems Inc.	40
Batch services	Control Data Service Bureau Corp.	$70
	Automatic Data Processing	66
Applications software	MRP Software International	$19
	Structural Dynamics Research Corp.	18
	Comserv	17
	Ask Computer Systems	7
	University Computing Company	6
Integrated systems	Computervision	$163
	GE/Calma	80
	Applicon	72
	Gerber	60
	MCAUTO	40

- There are no large leading independent companies in the application software sector of discrete manufacturing.

  - Eighty percent of MRP Software International's revenue is projected to come from the accounting/business area, and 20% from the manufacturing area.

  - Structural Dynamics Research Corporation (SDRC) is a highly specialized firm in the computer-aided design, analysis, and engineering area. It recently formed a joint venture company with General Electric called CAE International. This combination of SDRC's expertise and software and GE's resources and network could yield a significant increase in market activity in CAE.

  - Comserv specializes in MRP systems and is highly regarded. It typifies the independent firms focusing on manufacturing systems.

- Gerber's appearance as the number four ranked integrated supplier may come as a surprise, but this is based not only on its CAD systems revenue of $20 million, but also includes $40 million for its market systems used primarily in the garment industry.

- MCAUTO is showing very strong growth in the CAD systems sector as it continues to staff and pursue the market aggressively. While it is targeting CAD/CAM, it has many products and delivery modes, including integrated systems, applications software, RCS, and professional services. Although it offers products and services to all three functional areas, its main thrust is CAD/CAM to engineering and manufacturing.

IV MARKET FORECASTS

IV MARKET FORECASTS

A. OVERVIEW

- Exhibit IV-1 illustrates the incremental growth in user expenditures in the discrete manufacturing market from 1982 through 1987.

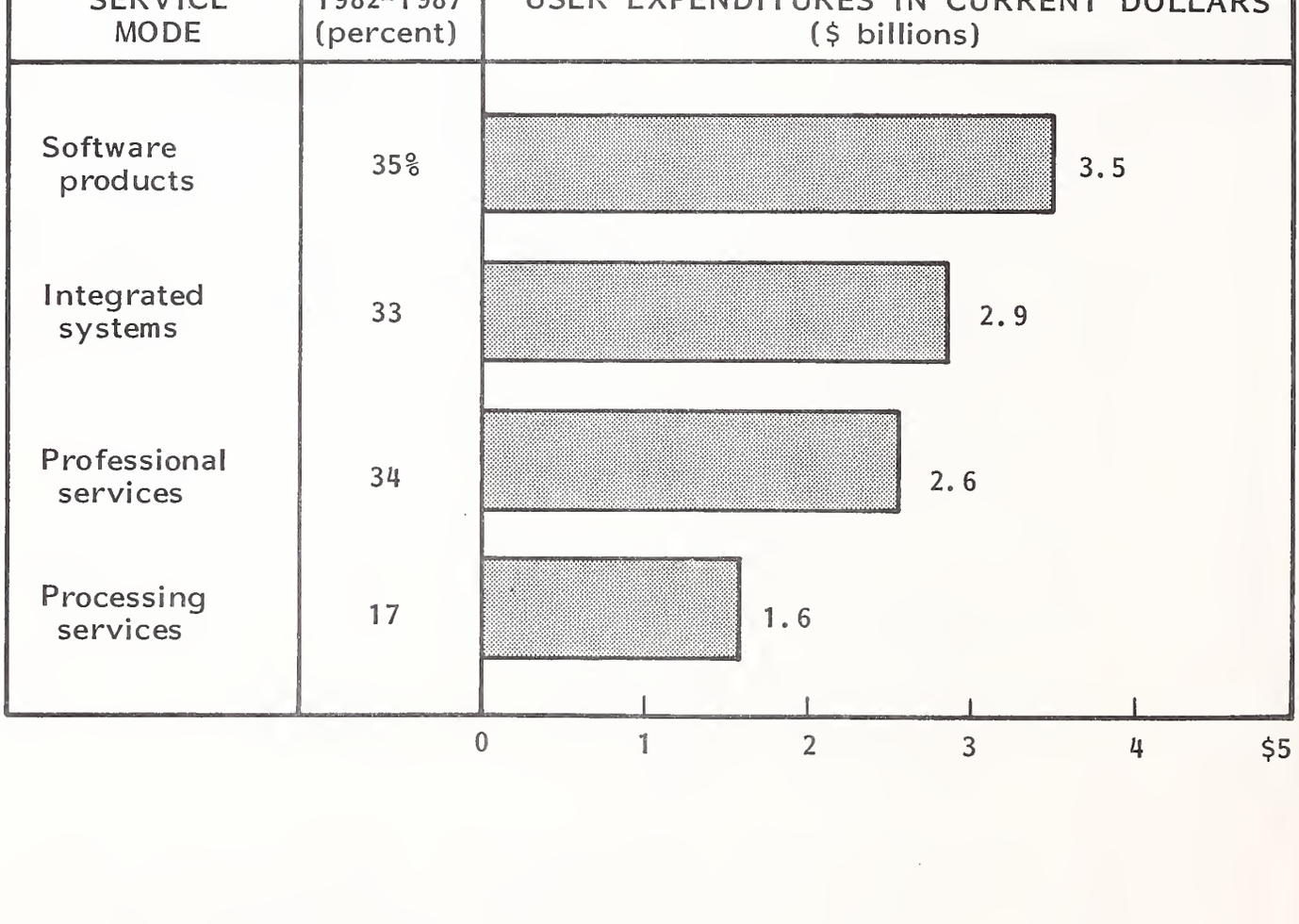
- Overall, discrete manufacturing expenditures are forecast to grow at a strong 30% rate. The largest segment in 1982, processing services, is forecast to grow at much less than the industry sector rate for all services due to the impact of lower-priced and more powerful hardware. This segment will also show the effect of the negative growth in real terms of batch services, again due to more cost effective systems.

- Software products show the strongest growth due to strong activity in systems software as corporate systems become more complex, integrated systems. Lower hardware costs will also hasten the penetration of systems into smaller user firms, resulting in greater expenditures for third-party utility software as well as operating software from the equipment vendor.

- Applications software is forecast to grow slightly less rapidly than systems software over the forecast period. However, this situation could change in the near future as companies use more sophisticated techniques in engineering and manufacturing. INPUT is closely monitoring this situation and will revise the forecasts as necessary.

EXHIBIT IV-1

INCREMENTAL MARKET GROWTH OF SERVICE MODES
IN U.S. DISCRETE MANUFACTURING, 1982-1987



- Professional services is the second-highest growth area in discrete manufacturing. Implementation of sophisticated manufacturing systems and large-scale integrated corporate information systems is beyond the capability of many user companies. Many firms are finding that they must adopt new systems and techniques to survive and remain competitive. Lacking the necessary resources, they turn to professional services firms for assistance. Many user firms are also turning to professional services because they cannot find qualified people for their in-house staffs.

- Integrated systems represent a significant area of user expenditures today, and are forecast to be the largest segment in 1987. Part of this growth is due to the proliferation of CAD systems. However, a significant share of the integrated systems will be for manufacturing planning and control. INPUT projects that the manufacturing organization will become a very heavy user of integrated systems for both CAD and production management.

- The market has held up very well through the earlier phases of the economic problems of the last 18 months, but now shows signs of softening. Even the usually robust CAD/CAM systems market is slowing in certain areas.

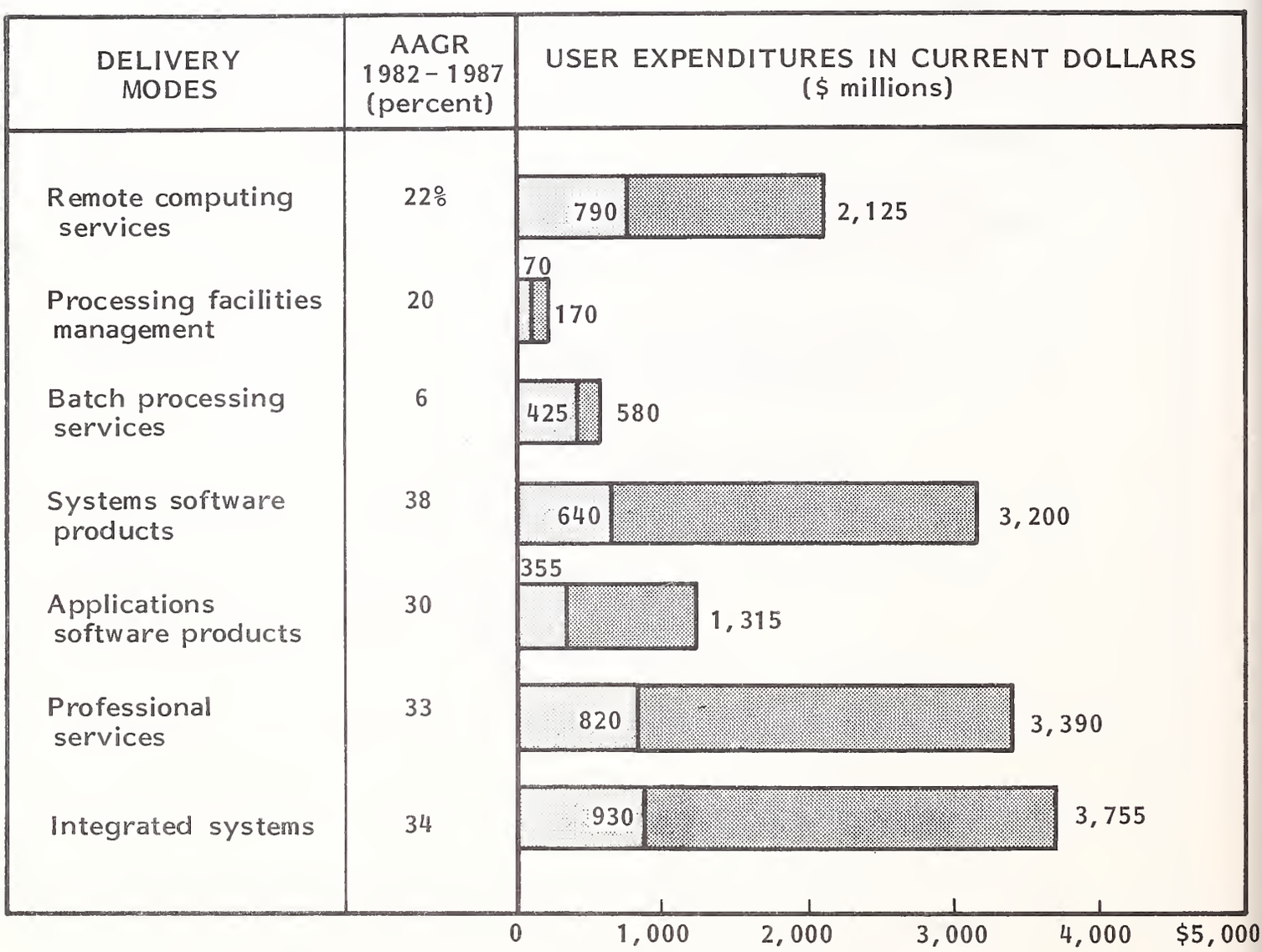
- This slowing could cause expenditures to fall below the forecast levels over the short term of 12-18 months, but they should recover to the forecast levels. The forces driving manufacturers to modernize their systems and techniques, improve their products, and raise productivity will not go away when the economy recovers.

B. DELIVERY MODE FORECASTS

- Expenditure forecasts by delivery mode are shown in Exhibit IV-2.

EXHIBIT IV-2

DELIVERY MODE FORECASTS



Total Expenditures

1982 - $4,170 million

1987 - $15,400 million

AAGR = 30%

- Software products, professional services, and integrated systems are forecast to grow faster than the overall rate because new users are entering the market and existing users are installing more sophisticated systems.

- Batch processing and FM growth rates reflect the impact of newer technologies. As systems performance rises and costs drop, these expenditures will be diverted to purchase in-house equipment.

- While RCS does not show a high growth rate, the size of the market leaves room for highly specialized or narrowly targeted vendors to successfully grow within segments at much higher rates.

- Forecasts for some delivery modes are broken down into three types of use: function-specific, industry-specific, and utility.

  - Definitions of these types of use are given in Appendix A.

  - Examples of typical products are shown in Exhibit IV-3.

  - Additional breakdowns of delivery mode forecasts are presented in Appendix B, Exhibits B-8 through B-14.

C. REMOTE COMPUTING SERVICES (RCS)

- RCS in discrete manufacturing will show strong growth at 22% compared to most other industry sectors, but somewhat slower than other delivery modes in discrete manufacturing.

- RCS continues to show strong resiliency in the face of higher communications costs and more powerful, lower-cost equipment.

EXHIBIT IV-3

SERVICE TYPE AND FUNCTIONAL AREA
PRODUCT EXAMPLES

SERVICE TYPE AND FUNCTIONAL AREA	TYPICAL PRODUCTS
Function-Specific	
Engineering	Project control Statistical analysis
Manufacturing	Project control Operations research/simulation
Business	Various general accounting and finance Financial modeling/forecasting
Industry-Specific	
Engineering	Circuit or structural design and analysis Mechanical or electronics simulations
Manufacturing	Materials requirements planning Numerical control programming
Business	Job and standard costings
Utility	
All areas	Programming languages and aids Data base management systems

- Vendors should pursue more specialized areas or narrow applications as the more general applications are taken in-house by users.

- Greater specialization will require vendors to invest in additional and sometimes different support skills.

I. RCS FORECASTS BY SERVICE TYPE

- As shown in Exhibit IV-4, function-specific expenditures will grow at a 15% average annual growth rate to $335 million by 1987.

  - Approximately 70% of this revenue comes from the business area shown in Exhibit IV-5 and consists of general accounting, payroll, personnel, and similar applications, mostly to medium-sized companies.

  - Large manufacturers such as aerospace or automotive companies will access financial modeling systems and proprietary data bases such as econometrics.

  - Function-specific expenditures by engineering and manufacturing are each estimated at 10%, or $15 million in 1982, growing to only $35 million in 1987.

  - Business area expenditures are forecast to increase from $137 to $266 million, an annual growth rate of 14%.

  - The function-specific market is highly competitive because there is so little product differentiation. It is relatively easy for vendors to enter this market segment and they usually do so by selling excess in-house system time.

- Industry-specific expenditures represent 65% of RCS expenditures in 1982, increasing to 73% by 1987.

EXHIBIT IV-4

REMOTE COMPUTING SERVICES FORECAST
BY SERVICE TYPE

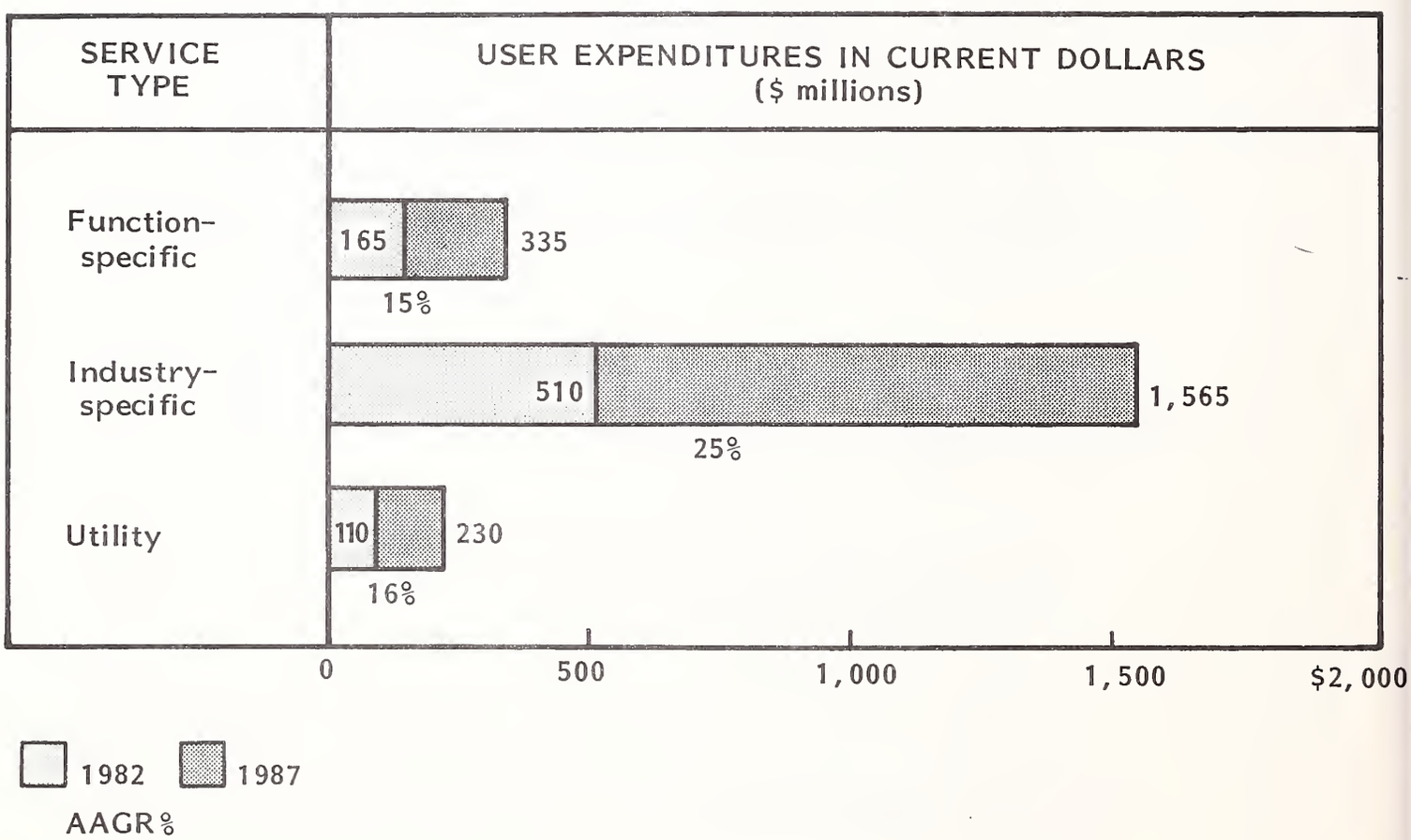


EXHIBIT IV-5

REMOTE COMPUTING SERVICES FORECASTS BY SERVICE TYPE AND FUNCTIONAL AREA ($ millions)

TYPE AND FUNCTION	1982	1983	1984	1985	1986	1987	AAGR (percent)
RCS/Function-Specific	$170	$190	$220	$255	$290	$335	15%
Engineering	15	18	21	25	30	35	18
Manufacturing	15	18	21	25	30	35	18
Business	140	155	180	205	230	265	14
RCS/Industry-Specific	510	635	800	995	1,245	1,565	25
Engineering	205	265	350	455	595	780	31
Manufacturing	280	335	405	485	585	705	20
Business	25	35	45	55	5	80	24
RCS/Utility	110	125	150	165	200	230	16
Engineering	55	60	70	75	85	90	11
Manufacturing	10	16	25	35	50	70	47
Business	45	50	55	55	65	70	9
Total RCS	$790	$955	$1,170	$1,415	$1,735	$2,130	22%
Engineering	275	345	440	555	710	905	27
Manufacturing	305	370	450	545	665	810	22
Business	210	240	280	315	360	415	15

NOTE: May not total due to rounding.

- This service type is dominated by the engineering and manufacturing areas, at $205 million (40%) and $208 million (55%) respectively in 1982, growing to $780 million and $705 million in 1987.

- Engineering uses RCS for large-scale analyses and simulations which cannot be performed in-house due to either lack of capacity or special software or because of turnaround problems.

- There is a limited use of interactive, graphics-based design due mostly to high data rate line charges. This will change somewhat with more powerful workstations and user site hardware services (USHS), but computer-intensive applications will still be emphasized.

- Engineering is forecast to account for 50% of all RCS industry-specific expenditures in 1987 as greater use is made of product simulation and testing techniques or CAE.

- An example of CAE RCS capabilities for mechanical products is a geometric modeler with integrated analysis programs.

- Manufacturing represents 55% of RCS industry-specific expenditures in 1982, dropping to 45% in 1987. Approximately 25% of manufacturing expenditures are for NC programming.

- NC on RCS will decline during the forecast period due to the growth of integrated CAD systems which have these capabilities implemented in a more effective graphics environment.

- The manufacturing area will make more use of sophisticated tools such as computer-aided process planning, and classification and coding systems. While these applications are more cost effective in-house, RCS will be useful for medium-sized users and for testing and evaluation.

- The business area expenditures for industry-specific RCS are forecast to be level at 5% of this service type, or $27 million in 1982 and $78 million in 1987. Applications in this category are specialized packages or general packages specially modified for areas such as cost accounting.

- Utility RCS is the smallest expenditure segment and is estimated to consist primarily of program development.

  - The engineering area is the heaviest user at $55 million in 1982 and $92 million in 1987.

  - Program development by and within manufacturing is currently estimated to be light at $10 million, growing to $68 million.

  - INPUT projects that more manufacturing organizations will establish their own DP capabilities and staffs with greater independence from the central management information system (MIS) group.

2. RCS FORECASTS BY FUNCTIONAL AREA

- The greatest expenditures and growth are forecast to result from engineering activities, as shown in Exhibit IV-5.

- Over 75% of engineering's expenditures will result from industry-specific processing, as shown in Exhibit IV-5.

  - The long-term benefits of exhaustive product computer simulation and testing are being proven. More reliable, lower-cost products can be developed in a shorter period using CAE techniques.

  - CAE developments and refinements over the next several years will spur new growth in engineering computing, including RCS.

- The recent joining of capabilities by General Electric and SDRC should bring in a number of CAE products to a broad market through the GEISCO network, GE/Calma, and their joint venture walk-in engineering centers.

- CAE will also require the development of extensive corporate engineering data bases.

- The data base systems represent one area of potential revenue, but an even greater one will result from RCS networks functioning as users' engineering networks for remote plant sites.

- The manufacturing area's RCS expenditures are presently greater than engineering's, but are projected to fall behind by approximately 12% in 1987, as shown in Exhibit IV-6.

  - INPUT feels that since the manufacturing area users are becoming more knowledgeable and hence more willing to use services, this area will show overall positive growth.

  - INPUT believes that small companies are an attractive segment and vendors should plan to pursue them aggressively.

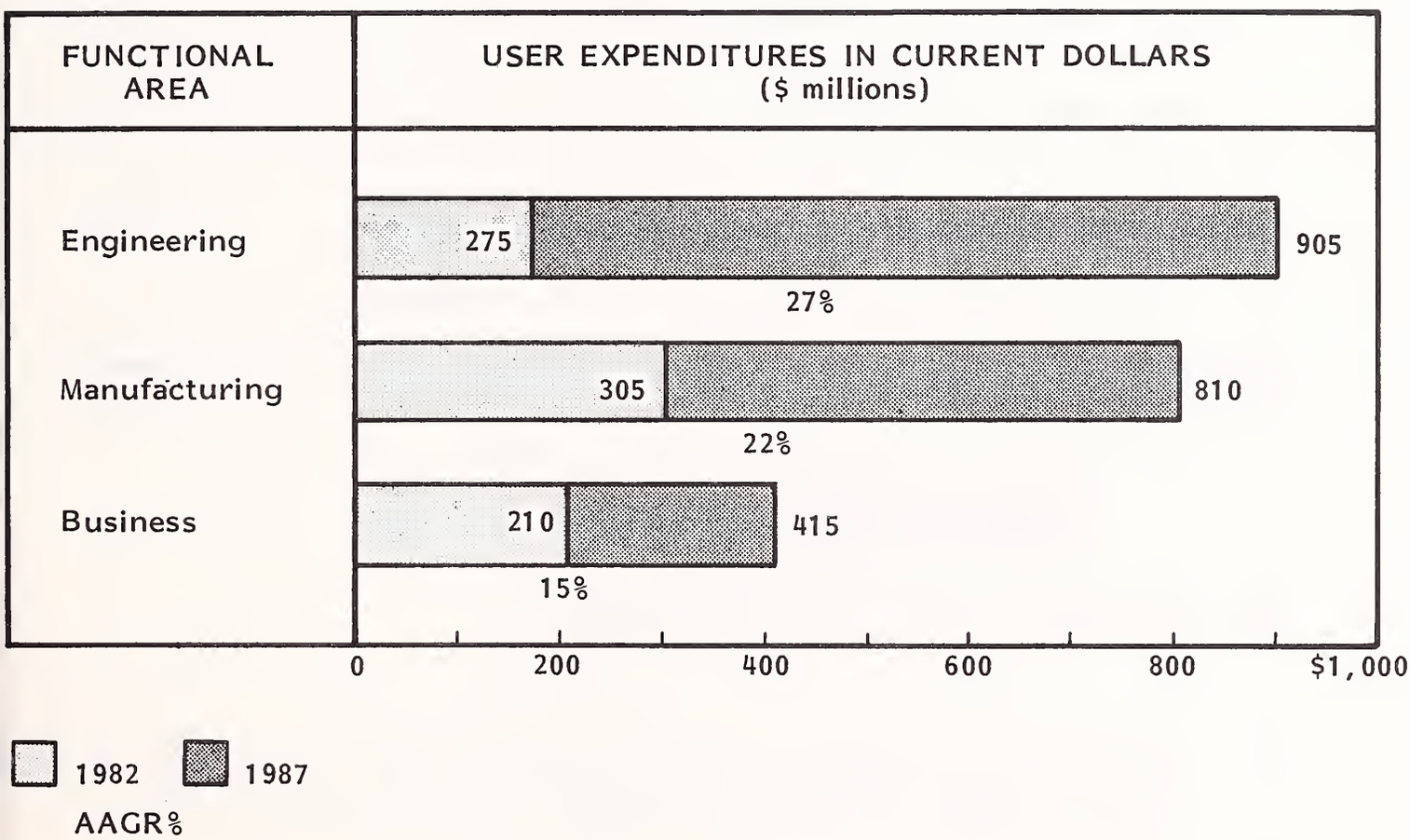
    . It is a large, virtually untapped market, but one which must be approached carefully.

    . The vendor must control and monitor activities to control support costs and account overhead.

    . On the positive side, small companies typically will not require an extensive product offering and, if properly cared for, will be excellent prospects for additional products and services as they grow.

EXHIBIT IV-6

REMOTE COMPUTING SERVICES FORECAST
BY FUNCTIONAL AREA



- RCS networks can be of great benefit to the manufacturing organization with multiple plant sites, but without an internal corporate communications network or resources for distributed systems.

- Vendors selling RCS to the manufacturing area will benefit somewhat from the poor economic conditions and the resulting limited capital for in-house systems.

- RCS can also function as a test of the effectiveness of an application in a user environment prior to the user making a large capital investment on in-house systems.

- The business area RCS expenditures come mostly from function-specific processing consisting of basic accounting for small- and medium-sized firms and forecasting/modeling for large and very large users. This segment will grow at a slower pace as it becomes more economical over time to take the basic accounting and finance operations in-house.

- While larger vendors still play a major role in the RCS discrete manufacturing market, small firms should find this market especially attractive because the diversity of user requirements creates many niches for small, flexible firms with specialized skills and knowledge.

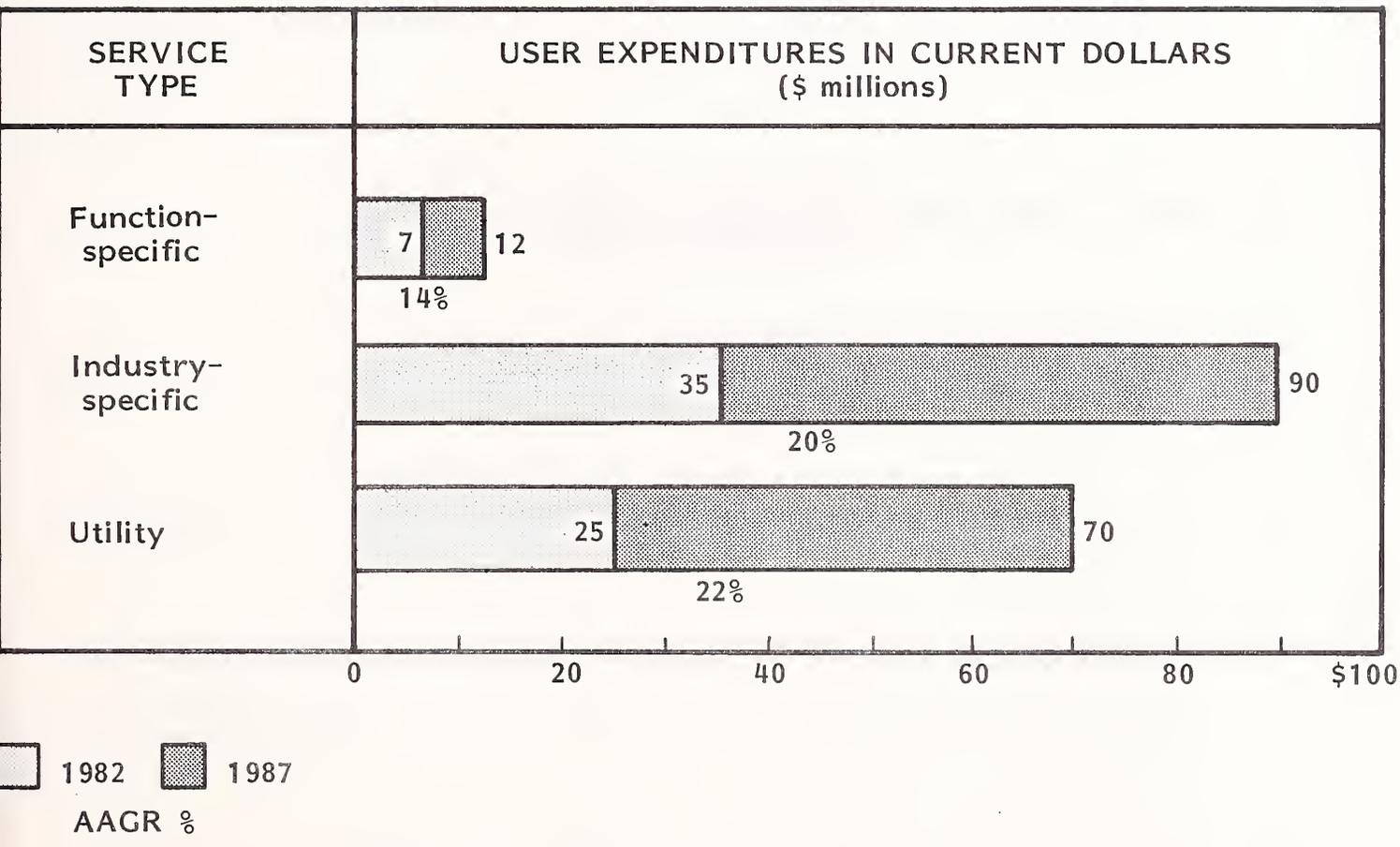
D. PROCESSING FACILITIES MANAGEMENT

- Processing FM is the smallest expenditure delivery mode in this market. It is projected to grow by 20% from $70 million in 1982 to $170 million in 1987.

- The small amount of function-specific expenditures shown in Exhibit IV-7 is solely from the business area and is primarily from small- to medium-sized firms.

EXHIBIT IV-7

PROCESSING FACILITIES MANAGEMENT FORECAST
BY SERVICE TYPE



- Industry-specific expenditures are estimated at 40% engineering and 60% manufacturing.

- The mix of expenditures for utility FM is 20% engineering, 40% manufacturing, and 40% business.

- A further breakdown of these expenditures is available to the reader in Appendix B, Exhibit B-8. The manufacturing area will continue to have the highest expenditures, as shown in Exhibit IV-8.

- Most of the growth in this service mode will take place as processing services vendors convert their customers to long-term contracts to help stabilize their revenue base, maximize profits from older or less support-intensive applications, and delay their clients' move in-house.

E. BATCH PROCESSING SERVICES

- Batch processing expenditures are projected to grow at only 6% from $425 million to $580 million.

- This represents negative real growth at the projected producers' price index growth rate of 10% per year.

- Function-specific expenditures, as shown in Exhibit IV-9, are the largest group because general accounting work is primarily done in batch mode for small firms.

- ADP and CDC are major national firms in this sector accounting for an estimated 30% of the total. The remainder is spread across a large number of vendors, mostly small regional companies or firms selling excess internal time.

EXHIBIT IV-8

PROCESSING FACILITIES MANAGEMENT FORECAST
BY FUNCTIONAL AREA

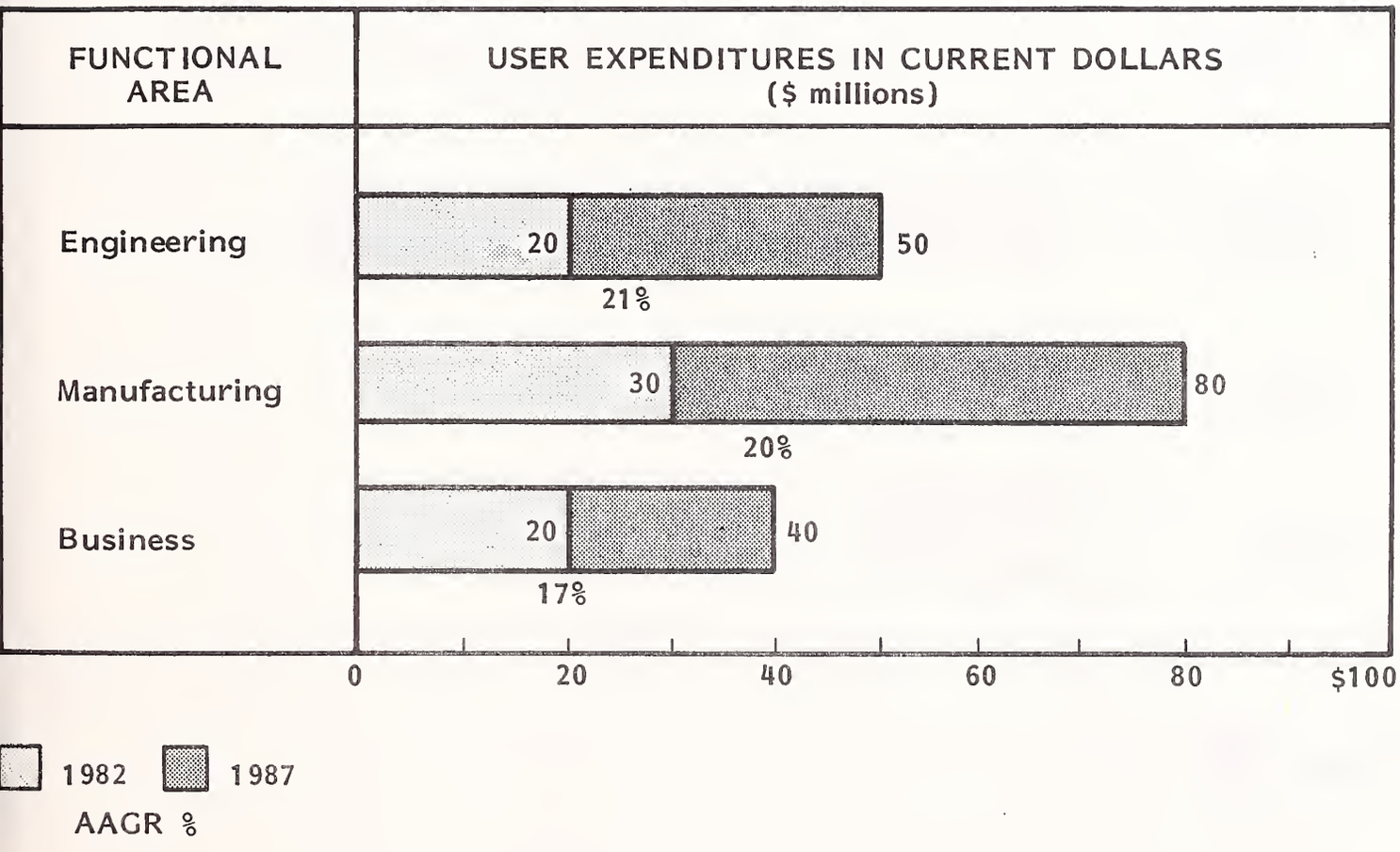
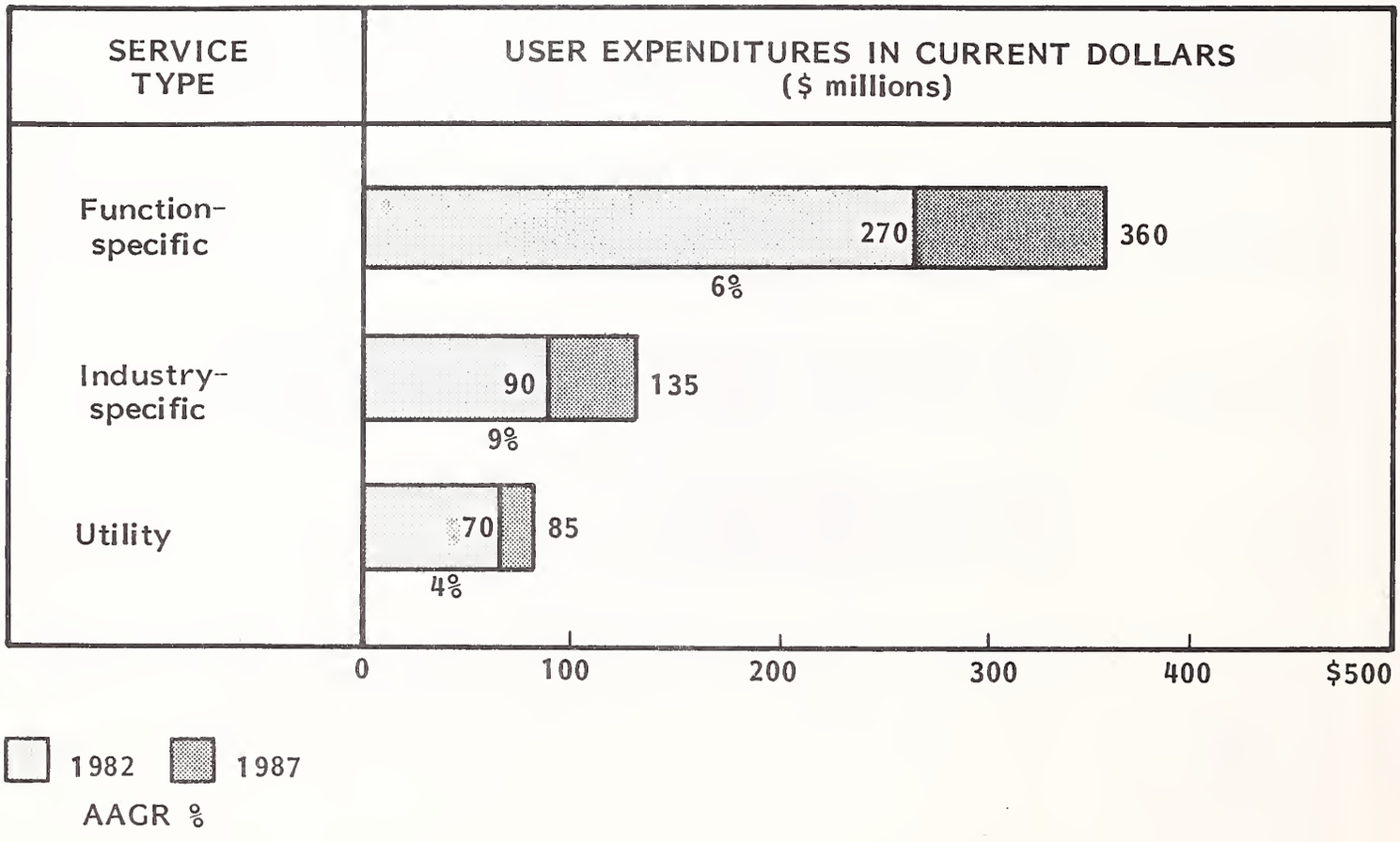


EXHIBIT IV-9

BATCH SERVICES FORECAST
BY SERVICE TYPE



- Industry-specific expenditures are entirely in the engineering and manufacturing areas. Manufacturing expenditures are forecast to be twice as great as engineering, as shown in Exhibit IV-10.

- INPUT recommends that batch processing services vendors operating in this market should take advantage of their application expertise by making RCS and/or integrated systems versions of their batch services available to clients and prospects whenever it is feasible to do so.

F. SOFTWARE

1. SYSTEMS SOFTWARE

- Systems software is forecast to grow from $640 million to $3,200 million, representing a compound rate of 38%. This is the highest growth area in discrete manufacturing.

- This forecast is based on a number of factors:

  - Continued unbundling of software by computer manufacturers.

  - The rapid growth in the number of new in-house systems, especially mini and microcomputers.

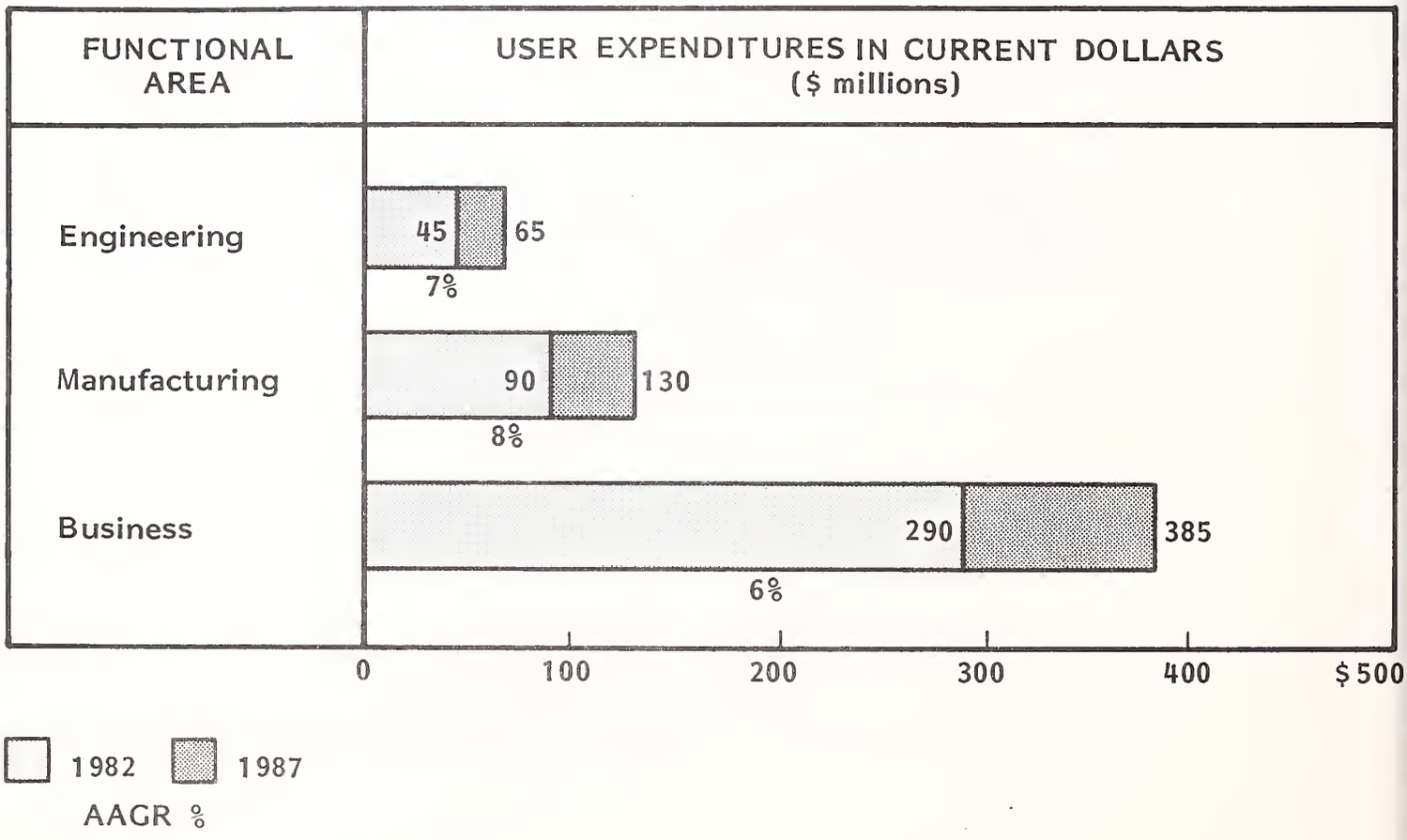
  - Increasing requirements for data base-oriented systems and distributed data bases.

  - Expansion of existing systems to accommodate remote, on-line devices.

  - The development of corporate DP systems into complex, distributed configurations encompassing machines from micros to mainframes.

EXHIBIT IV-10

BATCH SERVICES FORECAST
BY FUNCTIONAL AREA



- The largest share of system software expenditures will come from the business area because so many systems are concentrated in the MIS/EDP organizations. Systems software expenditures have not been broken into functional forecasts because the organizational source of the expenditure has no bearing on vendor considerations.

- Systems implementation products will grow at a higher rate than systems operation and utilization products.

  - Systems software vendors are advised to target their DBMS toward the financial and marketing functions.

  - These functions will draw upon implementation products to develop DSS.

  - Above average growth for these products is projected for systems designed to operate on super minicomputers.

2. APPLICATIONS SOFTWARE

- Applications software expenditures in the engineering area are small now, but will grow at a rapid 37% pace, as shown in Exhibit IV-11.

- This growth will be driven by the need for more intensive analysis and pre-prototype simulation and testing.

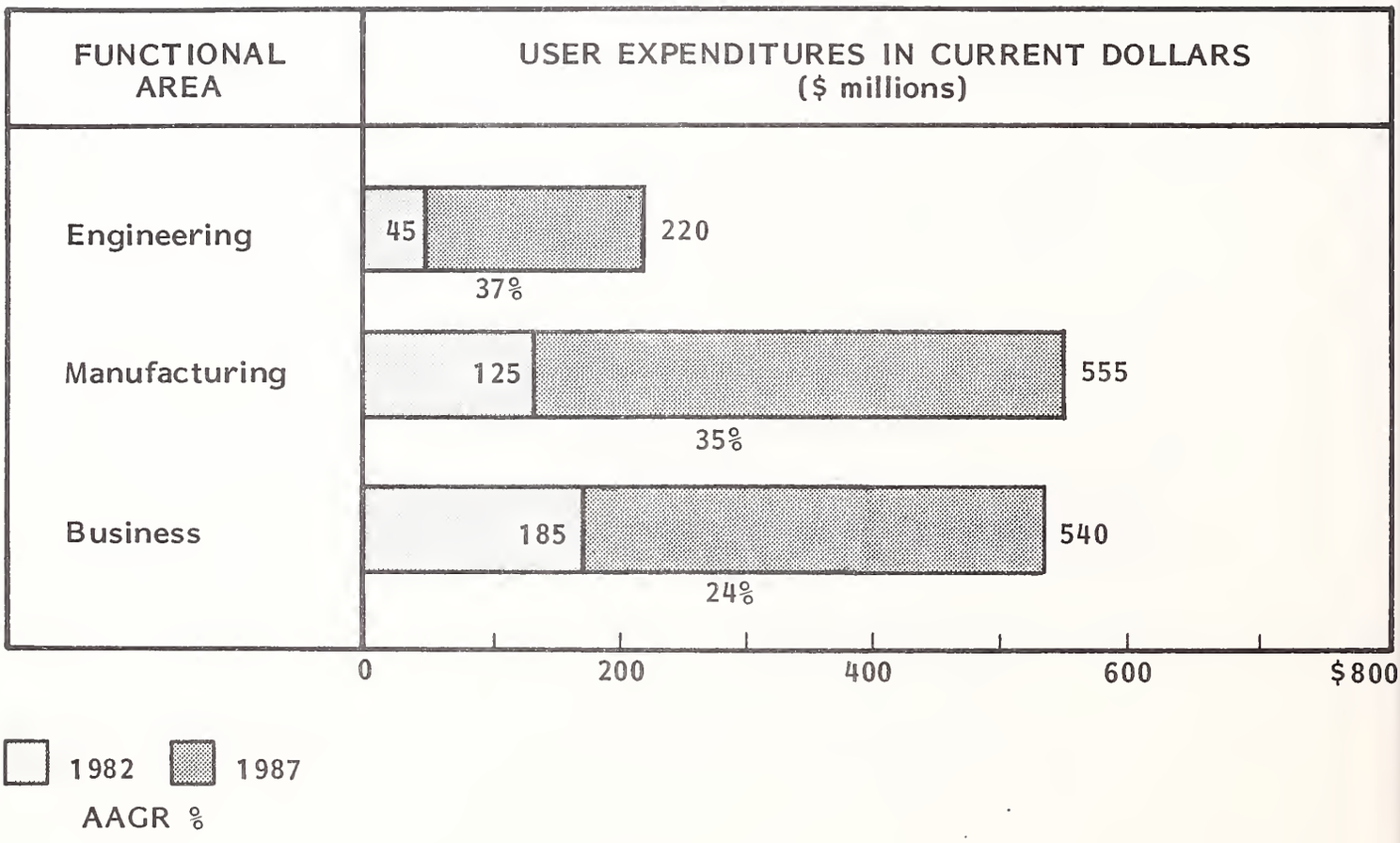
  - Even greater returns are predicted for CAE than for computer-aided design and drafting.

  - The use of CAE is limited now but will grow rapidly in the mid-1980s.

- The functional area projected to be the largest in 1987 is manufacturing. Software sales should increase rapidly as users learn more about the benefits and requirements for manufacturing systems.

EXHIBIT IV-11

APPLICATIONS SOFTWARE FORECAST
BY FUNCTIONAL AREA



- The business area is projected to grow less dramatically because it is a more mature market.

  - The basic business functions such as payroll, accounts receivable (A/R), and accounts payable (A/P) are the first to be automated.

  - Expenditures will come from system upgrades, and from an increasing number of new systems with integrated financial functions or capabilities for integration with other financial applications, as well as from manufacturing.

G. PROFESSIONAL SERVICES

- Professional services is forecast to be the second largest sector in discrete manufacturing, growing at 33% to $3.4 billion in 1987.

- Except for a minimal $5 million per year in FM, all expenditures will be for standard professional services.

- The professional services skills required will vary across the three functional areas:

  - Engineering will require specialists in computer-aided design, analysis, and simulation to establish integrated CAE systems.

  - Manufacturing area typically has a shortage of computer-experienced people to plan and develop systems and train the end users. Education is critical in this area since manufacturing people are usually not as familiar with DP concepts or terminology as are other functional areas.

  - The business function is a long-time user of professional services in the system design and contract programming areas for general business

applications and occasionally for specialized applications in the engineering and manufacturing areas.

- Exhibit IV-12 shows the projected mix of expenditures in the three functional areas.

- The manufacturing area will grow rapidly, overtaking the business area by 1987 due to a chronic shortage of skilled programmers and analysts who are also knowledgeable in manufacturing systems.

- The manufacturing area firms vary greatly in the way they conduct their operations and a high degree of customization is often required of standard software packages.

  - Even if the unique requirements are not real, a person with special skills must still make the determination, and sometimes, the implementation.

  - Vendors to this function report great difficulty in finding and retaining adequately skilled, manufacturing-knowledgeable people.

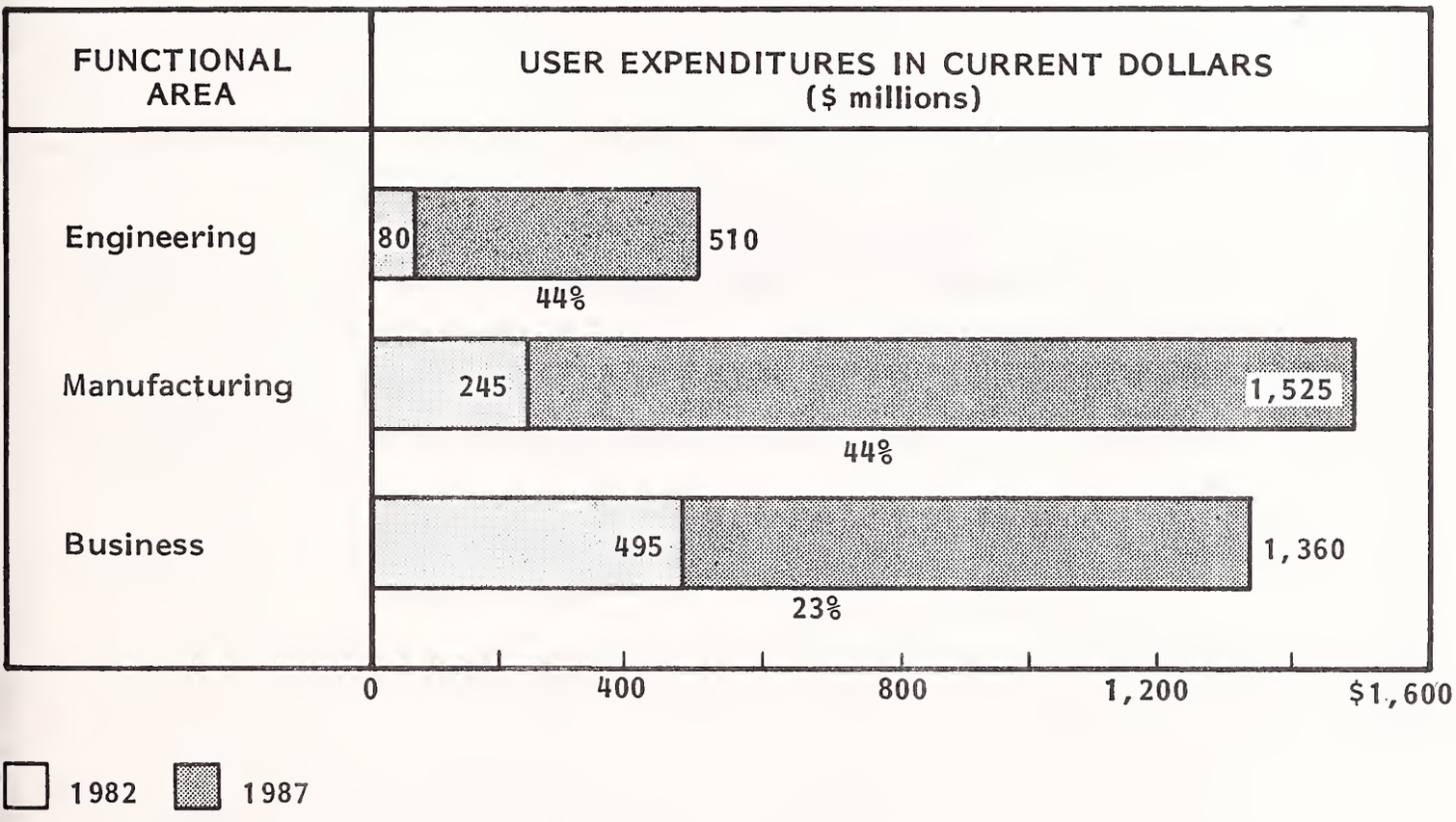
H. INTEGRATED SYSTEMS

- This is the largest expenditure class in discrete manufacturing and is forecast to exceed $3.7 billion in 1987.

  - An integration of systems and applications software with hardware is packaged as a single entity. The value added by the vendor is primarily in the software. Most CAD/CAM systems and many small business systems are integrated systems. This does not include specialized hardware systems such as word processors, cash registers, process control systems, and military weapon systems.

EXHIBIT IV-12

PROFESSIONAL SERVICES FORECAST
BY FUNCTIONAL AREA



- Products sold by companies which are primarily computer manufacturers are generally excluded.

- The business area is slightly larger than the manufacturing area, as shown in Exhibit IV-13. This area is projected to grow a little faster than engineering but not as fast as the manufacturing area.

  - There are many general business applications packages being integrated with small systems for the business requirements of small to medium size manufacturing firms.

  - Very little customizing is required and installation is usually straightforward.

  - Integrated systems expenditures for this area will grow fastest for small systems sold to small firms.

- Engineering and manufacturing systems often are either difficult to interface to the computer system or require significant customizing.

- Engineering integrated systems expenditures include a number of system types:

  - Mechanical CAD systems.

  - Electrical/electronic CAD systems.

  - Special-purpose engineering analysis and CAE systems.

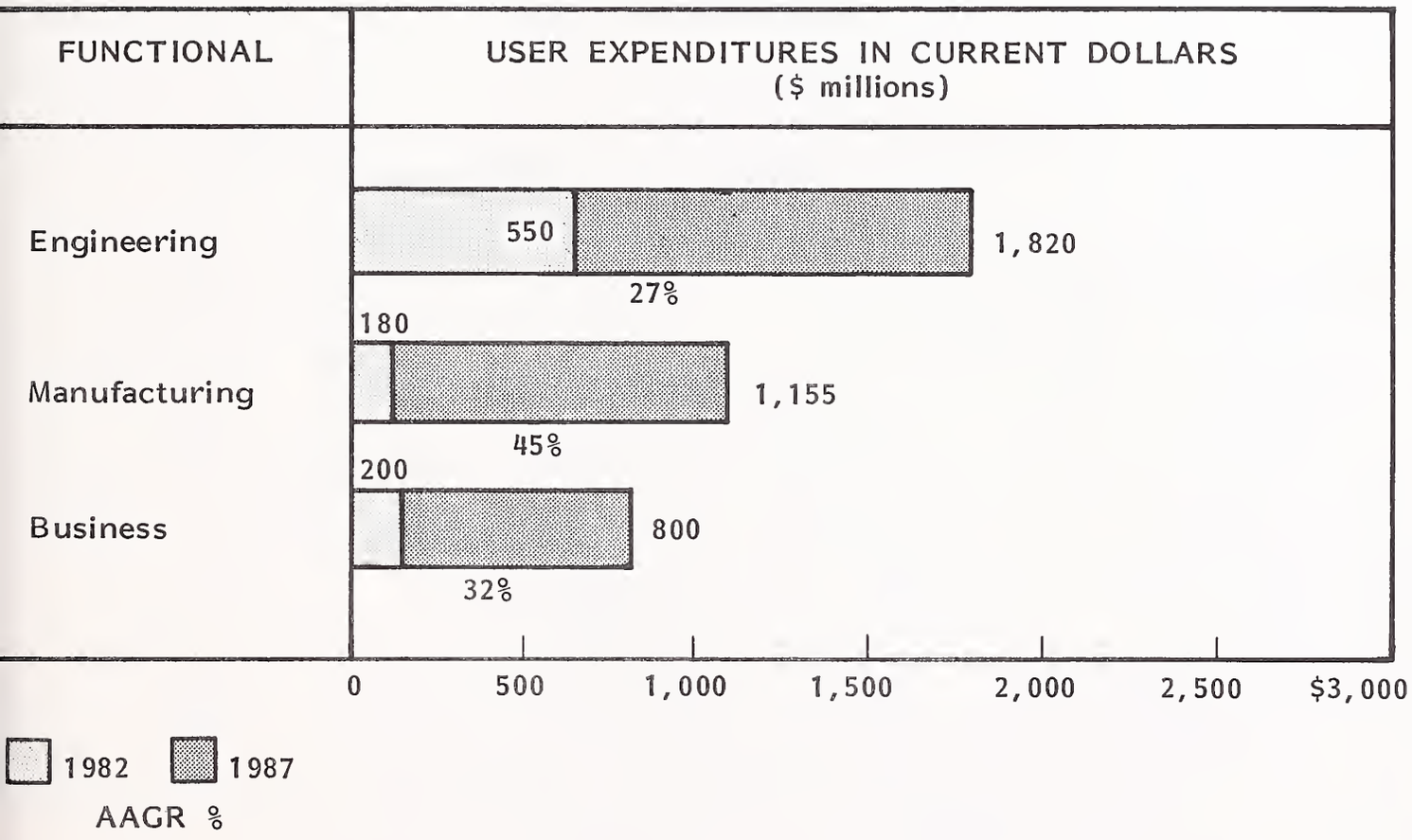
- Manufacturing expenditures also include various system types:

  - Mechanical CAD systems.

  - Manufacturing planning and control systems.

EXHIBIT IV-13

INTEGRATED SYSTEMS FORECAST
BY FUNCTIONAL AREA



- NC and other machine control, such as direct NC, shop floor data collection systems, and robotics programmers/controllers.

- Pattern worker and other special purpose systems.

- A detailed breakout of manufacturing and engineering integrated systems expenditures may be found in Appendix B, Exhibit B-14.

- Vendors planning to offer integrated systems to the manufacturing sector should beware of and plan to address the following challenges:

  - Manufacturing can be a very complex business and vendors must have in-depth industry knowledge to succeed.

  - It is very resource-intensive because customizing, training, conversions, and other implementation tasks are required.

  - Decision and implementation cycles can be long due to the pressure of ongoing business.

V USER ISSUES

V USER ISSUES

A. INTRODUCTION

- This chapter analyzes user needs for and attitudes toward computer services in the discrete manufacturing sector.

- Users interviewed, as shown in Exhibit V-1, correlate closely with the distribution of industry shipments and number of establishments.

- The size profile of user respondents is shown in Exhibit V-2.

  - The users surveyed are not representative of the overall industry because they are skewed toward the larger firms, but they represent the establishments with the highest buying potential.

  - Seventy-eight percent of the interview sample consists of medium to very large companies. Although this segment represents a small percentage of the number of companies in the industry, it accounts for a significant share of DP-related expenditures.

- The respondents were dispersed across all geographic areas, with the heaviest concentrations in the East North Central, West South Central, and Pacific sections of the country.

EXHIBIT V-1

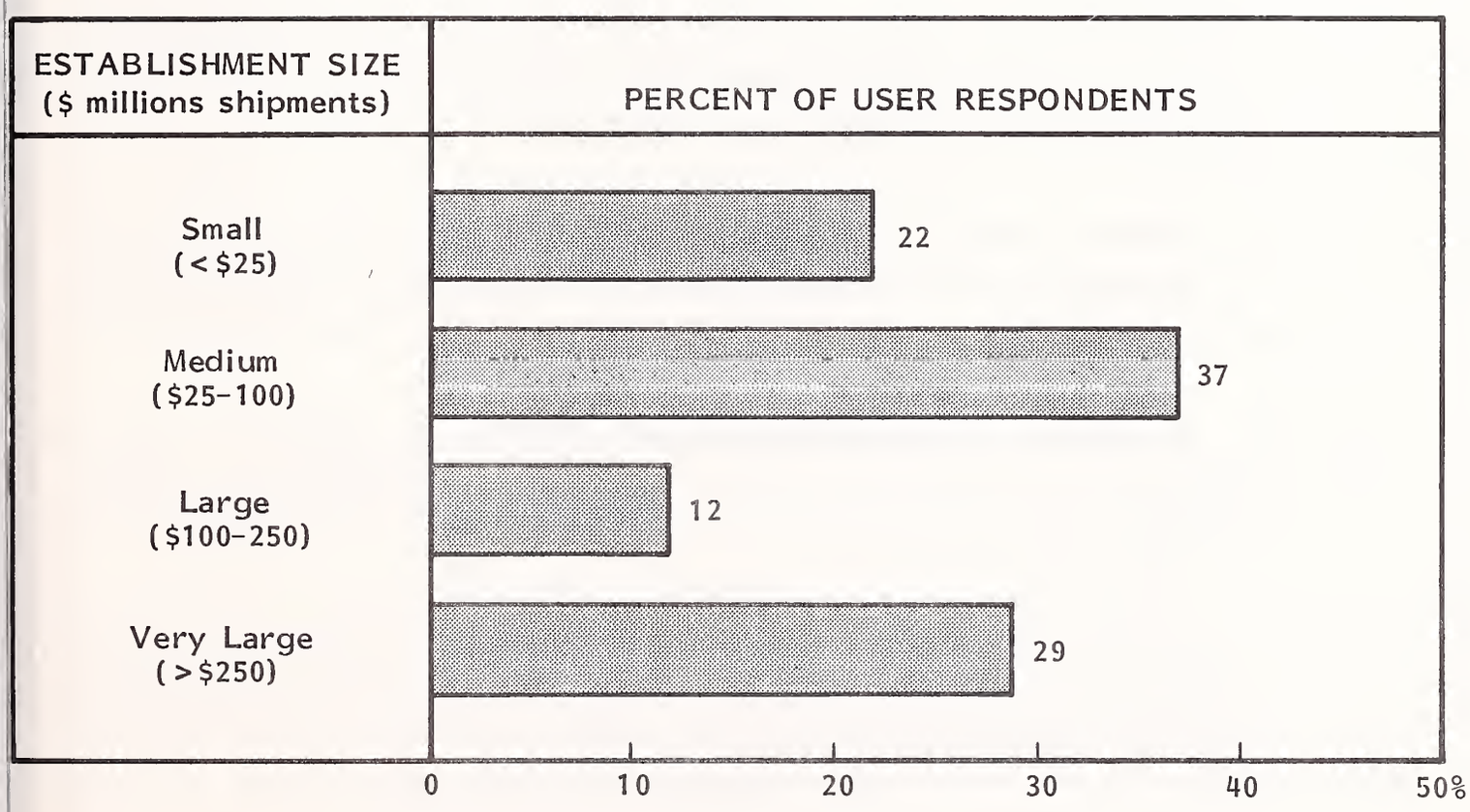
INDUSTRY DISTRIBUTION OF USER RESPONDENTS

SIC *	INDUSTRY	NUMBER OF RESPONDENTS	PERCENT OF SAMPLE
23	Apparel	2	4%
25	Furniture	3	6
27	Printing	2	4
30	Rubber and plastics	0	0
31	Leather	1	2
34	Fabricated metal	10	19
35	Machinery	14	27
36	Electrical/electronics	7	13
37	Transportation	5	10
38	Instruments	3	6
39	Miscellaneous Manufacturing	5	10
TOTAL		52	100% †

* Standard Industrial Classification
† Column may not total due to rounding.

EXHIBIT V-2

DISTRIBUTION OF USER RESPONDENT
ESTABLISHMENT SIZES



- Fifty-eight percent of the respondent sites were headquarters locations and 42% were plants or other sites.

- As shown in Exhibit V-3, most respondents were in the MIS or DP organization. This situation will change as systems become more widely distributed and the end users install more powerful and flexible systems.

- Multiple interviews were conducted at 10 sites yielding a total of 62 users interviewed. These were to gain additional expenditure data when the DP respondent was not informed about expenditures in the other areas.

B. BUDGET CONSIDERATIONS

- Exhibit V-4 clearly shows that the EDP/MIS organization holds an important position among the user sample because it controls all budgets for computer products and services in 65% of the organizations.

- No significant distribution trends by establishment size or SIC were detected. Small establishments were skewed toward EDP budget control, but this stands to reason in a small organization.

- The DP budget is allocated by functional area, as shown in Exhibit V-5. Where budgets are not allocated by functional area, then this exhibit represents the utilization of DP resources.

- Forty-eight percent of the respondents projected the allocation/utilization ratios to remain the same, while 44% anticipated increases in the engineering and/or manufacturing areas, as shown in Exhibit V-6.

- Respondents' DP budget growth distribution from 1981 to 1982 is shown in Exhibit V-7. The changes ranged from -33% to +61%, with an overall average increase of 16.7%.

EXHIBIT V-3

USER RESPONDENT ORGANIZATIONAL LEVELS

ORGANIZATIONAL LEVELS		NUMBER OF RESPONDENTS
DATA PROCESSING (79%)	VP/Director, MIS or Information Services	14
	Manager, Data Processing	28
	Director/Manager, Systems & Programming	4
	Other Managers	3
ENGINEERING (10%)	VP, Engineering	1
	Manager, CAD/CAM	2
	Manager, Engineering Services	2
	CAD Specialist	1
MANUFACTURING (8%)	Director, Distribution	1
	Chief Industrial Engineer	1
	Production Manager	1
	Manager, Manufacturing Services	1
	Manager, Manufacturing Systems	1
OTHER (3%)	President	1
	Manager, Accounting	1
TOTAL USERS INTERVIEWED		62*

* Two interviews each were conducted at 10 of the 52 companies surveyed.

EXHIBIT V-4

USER RESPONDENT BUDGET CONTROL OF
COMPUTER PRODUCTS AND SERVICES

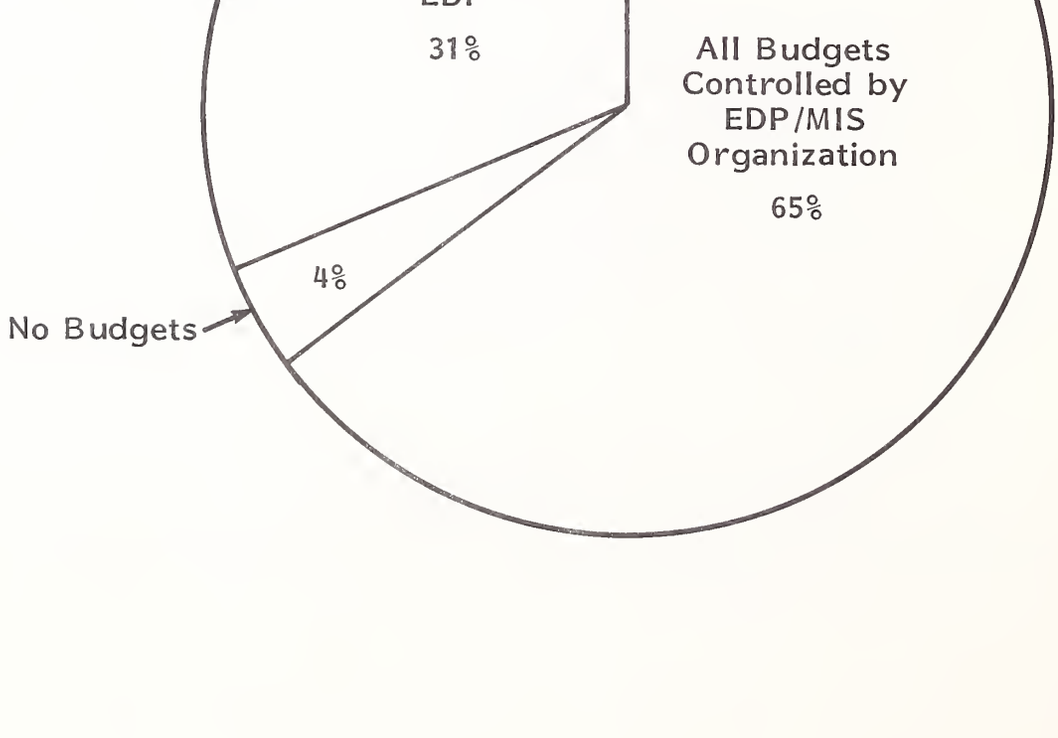


EXHIBIT V-5

DATA PROCESSING BUDGET ALLOCATION
BY FUNCTIONAL AREA

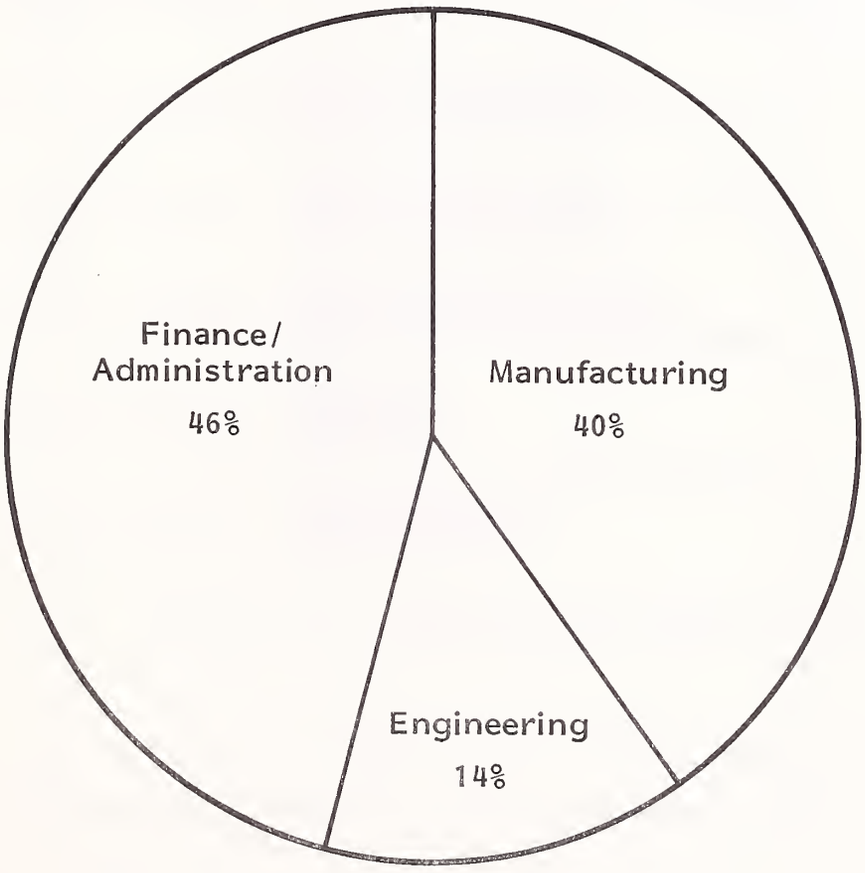


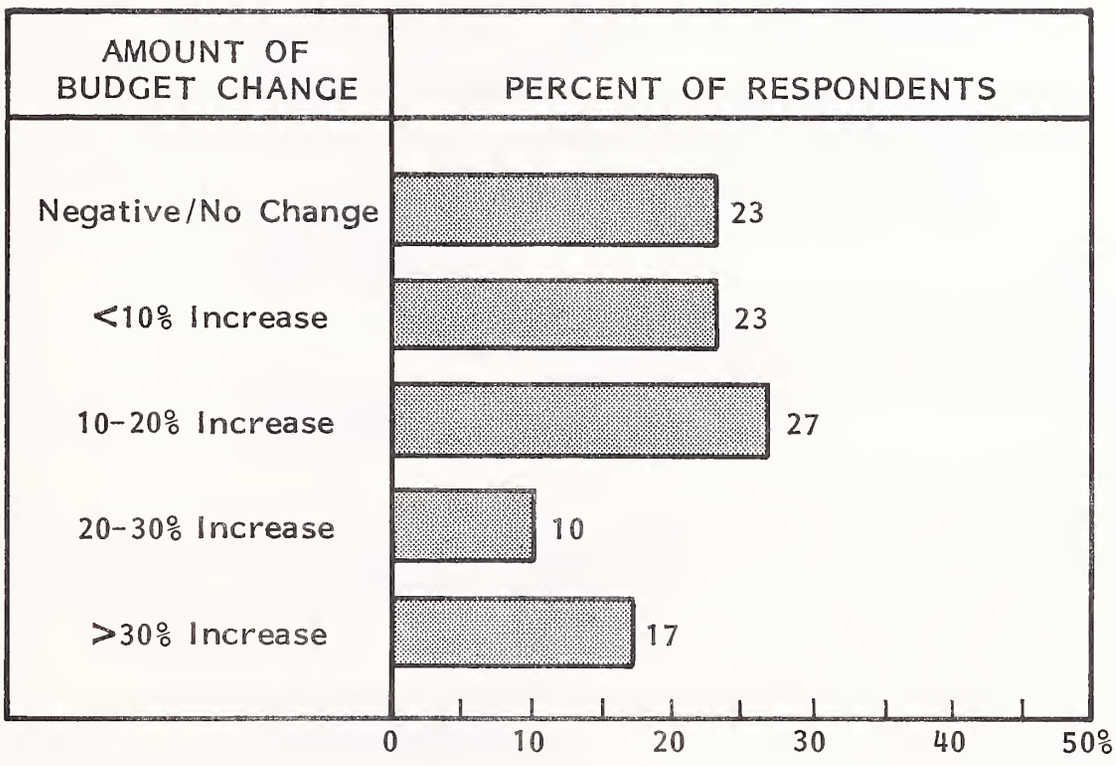
EXHIBIT V-6

DATA PROCESSING BUDGET ALLOCATIONS - ANTICIPATED CHANGES

ALLOCATION INCREASES FOR:	PERCENT OF RESPONDENTS
None	48%
Engineering and Manufacturing	19
Engineering	15
Manufacturing	10
Finance/Administration	4
Unspecified	4

EXHIBIT V-7

DATA PROCESSING BUDGET GROWTH,
1981-1982



- Very large users reported an average increase of 19%.

- The smallest average increase was in the large segment at 13%, while the small and medium segments reported increases of approximately 17% each.

- Only 15 respondents would venture a firm estimate of their budget growth from 1982 to 1986.

  - The overall average was a 47% increase, with estimates ranging from -7% to +122%.

  - Of the remaining respondents, 34 projected budget increases, with only three projecting decreases.

C. APPLICATIONS INTEGRATION

- Corporate DP managers may not be directly involved in all DP-related expenditures, but they can be expected to exert their influence in one way or another. They are still important enough in most companies that they must be recognized as a key element in major computer expenditures.

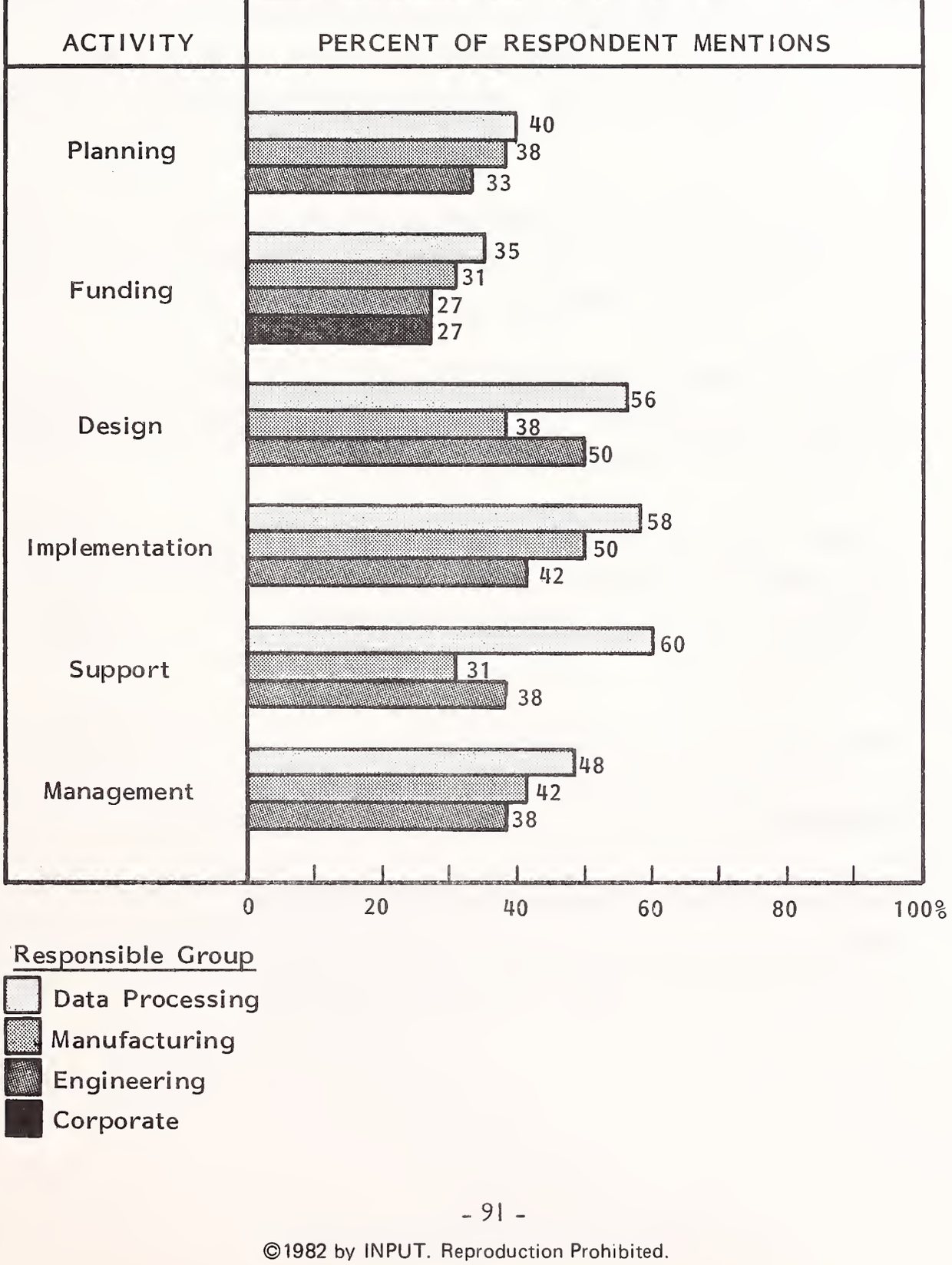
- This situation will continue and probably intensify, even with the increased sales of integrated systems directly to other functional areas.

- Corporate management is beginning to appreciate the need for an eventual integration of various application systems within their operation.

- Applications integration will usually put the EDP organization back in a strong central role, even in companies with distributed systems. This point is made very clearly in Exhibit V-8 where DP was mentioned as a party responsible for applications integration more than any other organization.

EXHIBIT V-8

RESPONSIBILITIES FOR INTEGRATED ENGINEERING AND MANUFACTURING APPLICATION SYSTEMS



- The "percent of respondent mentions" totals more than 100% for each activity because joint responsibilities were cited.

- Other organizations were mentioned such as CAD/CAM manager, corporate steering committee, and third party which was taken to mean an outside consultant. These other organizations were not mentioned with any significant frequency.

- One conspicuously absent organization was finance. While it was mentioned as a participant in every activity, it was mentioned by only 8% of the respondents for each activity.

- Integrated CAD and CAM systems must interface with financial systems for the transmission of cost and other data. Accurate financial data must be available for corporate needs.

- While it is true that the DP organization usually knows a great deal about financial applications and systems, it cannot and should not represent the broader concerns of the financial organization.

- Exhibit V-9 further clarifies the relationships among various organizations in the applications integration effort. While DP is involved in all activities in 62% of the cases, it is only involved with both manufacturing and engineering in 23% of the cases.

- The eight respondents who reported efforts by engineering and manufacturing without DP involvement are unusual in that they are obviously technically self-sufficient.

- There was no strong correlation with establishment size for this response. Although four of the respondents were with very large firms, the other respondents were with small, medium, and large firms.

EXHIBIT V-9

ORGANIZATIONAL INVOLVEMENTS IN
INTEGRATING APPLICATIONS SYSTEMS

ORGANIZATIONAL INVOLVEMENTS	NUMBER OF RESPONDENTS	PERCENT OF RESPONDENTS
Data processing:		
- as sole organization in all activities	4	8%
- with manufacturing only	7	13
- with engineering only	6	12
- with manufacturing and engineering	12	23
- with steering committee	3	6
Data Processing Subtotal	32	62%
Engineering and manufacturing:		
- jointly without DP involvement	8	15
Manufacturing:		
- as sole organization in all activities	2	4
Engineering:		
- as sole organization in all activities	3	6
Finance/administration	4	8
Unknown or no response	3	6
TOTAL	52	100%

NOTE: Percentages may not total to 100 due to rounding.

- Responses to the applications integration responsibilities question show relationship or communication problems. It is difficult to understand how one or two organizations could undertake such a critical task without the involvement of the third (the three being manufacturing, engineering, and DP).

- The MIS manager from a very large fabricated metal products manufacturer said, "EDP and engineering are foreign to each other. It is difficult to get them to see the use in integrating the two areas and systems. CAD will bring them together."

- The problem of communications among these three groups can be very real. Vendors must never forget they are dealing with different perspectives and levels of DP knowledge among the groups. Treating them all as though they were DP-oriented could have a disastrous effect on sales efforts.

- Obstacles to applications integration cited by users included resources, user expertise and knowledge, cost, and lack of communications between departments. No unusual or surprising obstacles were mentioned, but the issue of poor interdepartmental communications was prominent.

- Eighty-six percent of the respondents reported no integrated applications today. Of those, 53% have no plans for integration; 40% are looking at it or planning to investigate it, and only 7% have plans in place.

- Twenty-five percent of the respondents reported CAD system installations. Of those, 36% have plans for applications integration in place. Sixty-four percent report they have no plans in place and are not considering them.

- CAD installations were reported by a cross-section of establishments from small to very large and SICs 23 and 34 through 39.

D. KEY APPLICATIONS AND PLANS

1. ENGINEERING

- Respondents were asked to list the key applications being processed on their central in-house systems, new systems or applications implemented in 1981, and major new implementations planned for 1982. Responses are summarized below by functional area and shown in Exhibit V-10.

- Engineering was the most poorly defined of the respondent groups as far as key applications were concerned, as can be seen in Exhibit V-10.

  - The only application receiving wide mention was BOM, which was cited as a key application by 29% of the 52 respondents.

  - Design was mentioned by 13% of the respondents, but no specifics were given of the type of design or level of sophistication.

  - Other applications mentioned were finite element modeling, project scheduling and control, calculations (unspecified), analysis (unspecified), and simulation (unspecified).

- Most of these responses were given by DP managers and show the lack of importance given to engineering computing in many companies.

  - Unless engineering has enough resources for its own DP facility or commands a significant share of a central one, it is often given a lower priority than the other functional areas.

  - INPUT predicts a change in this situation as companies learn the advantages of applying computer technology to the engineering process.

EXHIBIT V-10

RESPONDENTS' KEY IN-HOUSE APPLICATIONS

ENGINEERING AREA	NUMBER OF MENTIONS	MANUFACTURING AREA	NUMBER OF MENTIONS	BUSINESS AREA	NUMBER OF MENTIONS
Bills of materials	15	Inventory	33	Accounts receivable	40
Design	7	Materials requirements planning	15	Accounts payable	40
Finite element modeling	2	Shop floor control	10	General ledger	26
Analysis	2	Production control/ scheduling	7	Payroll	25
Project control	2	Routings	6	Order entry	15
Records	1	Master scheduling	6	Invoicing/billing	9
Industrial engineering	1	Capacity requirements planning	3	Purchasing	5
Simulation	1	Labor reporting	3	Sales order analysis	4
		Standard costing	2	Cost accounting	3
		Tool control	2	Personnel	3
		Numerical/control	1	Costing	3
		Job estimating	1	Budgeting	1
		Quality assurance	1	Cash flow analysis	1
				Billing analysis	1
				Fixed asset accounting	

- As the benefits of CAD systems become more apparent to management, so does the potential for productivity improvements.

  - The early emphasis of CAD systems was on productivity gains resulting from the automation of the drafting process and some design activities.

  - This saved manpower in engineering, but did little for other, downstream organizations and operations.

- The use of CAE techniques and closer integration of the engineering and manufacturing systems will result in greater cost savings than the present, mainly independent uses of computing. Well downstream of the automated processes, benefits will be realized such as less costly maintenance due to thorough CAE modeling and simulation.

- INPUT predicts that this new attention on engineering will mean higher budget levels and a higher priority for engineering needs, even though increased emphasis on engineering was not apparent from responses concerning key 1981 and 1982 implementations.

  - Only a few applications were mentioned for 1981 including on-line BOM and design and graphics (both unspecified).

  - Major 1982 plans were slim as well, consisting of on-line BOM, BOM, and finite element modeling.

- Among the respondents, attention paid to engineering computer aids has not increased in most companies and/or DP management does not consider engineering computing to be an important need.

- Vendors will have to sell potential users on the benefits to be derived from automating these areas in order to succeed.

2. MANUFACTURING

- Manufacturing was mentioned more often than engineering as a key application.

  - A total of 90 applications were listed in 16 specific areas, as shown in Exhibit V-10.

  - This contrasts with 31 applications in 11 less specific areas for engineering.

- As could be expected, inventory was the application listed most frequently (63% of the respondents).

- MRP was only mentioned as a key application by 29% of the respondents.

  - MRP responses were most frequent in medium and very large size companies respectively.

  - Fabricated metal manufacturers (SIC 34) had the highest number of responses, followed by machinery (SIC 35) and electrical/electronics (SIC 36).

- Although the level of implementation of MRP systems was not surveyed in this project, it is probable that all of the MRP respondents did not have fully implemented systems.

  - MRP system implementations require extensive user and vendor efforts over a long period of time.

  - A vendor should not interpret the mere presence of an MRP system at a user site as a lost opportunity without further investigation to determine the extent of use and customer satisfaction.

- Key 1981 system implementations were led by MRP (21% of applications mentioned) and inventory (13% of applications mentioned). Seventeen percent of the key implementations cited by respondents were for conversions. This is a significant level and indicates an opportunity for vendors to displace existing systems.

- Major 1982 plans followed the same pattern, with inventory and MRP mentioned most frequently. There are no unusual or remarkable features of the reported present and planned manufacturing applications.

- Manufacturing is continuing to implement computer aids enthusiastically. The survey data do not show whether the systems are being implemented on a piecemeal basis or as integrated systems, but the former is probably the case.

- Although manufacturing applications have been available for some time, few companies have current, comprehensive systems installed, leaving ample opportunities for vendors.

3. BUSINESS

- The key applications being processed by respondents are the core financial applications of A/R and A/P (77% reporting), general ledger (G/L) (50%), and payroll (48%), as shown in Exhibit V-10.

- Twenty-nine percent of the respondents reported order entry as a key application, followed by invoicing/billing (17%) and purchasing (10%). Other applications included sales order analysis, standard costing, forecasting, personnel, profit analysis, and fixed asset accounting.

- Installed applications drop off steeply after the basic ones of A/R, A/P, and G/L. Responses to key 1981 implementations and 1982 plans show that the core applications are in place and capabilities are being added in other areas.

- Respondents' plans for 1982 covered a broad area, with only minor mentions of the basic accounting functions. The sales and marketing area was most prominent, including sales order entry, marketing, market simulation, and forecasting/modeling.

- On-line capabilities were mentioned in 19% of the 1982 plans. The most frequently mentioned on-line application was A/R.

- While the business area is the most deeply penetrated by information services vendors, it was also the first, so that many of the installed applications are approaching obsolescence.

- There are vendor opportunities for upgrades of core applications, but even more for on-line, integrated, and data base-oriented systems.

4. PRODUCT NEEDS

- When asked what products or services they would like to have that are not now available, most respondents replied "nothing" or "none."

- Most felt that adequate products and services were available today, but five respondents were concerned about integrating applications systems.

  - "This won't happen for five years, but would like to have an integrated CAD system . . . in conjunction with the manufacturing system . . . and work off the same data base." Another respondent listed the same requirement.

  - Other needs were to integrate manufacturing and finance, manufacturing and market forecasting, and multiple CPUs with a common data base.

- Fifteen percent of the respondents listed products or systems that are available on the market today while another 10% listed relatively minor functions that may be available.

- Manufacturers are not hindered by a lack of available products or services, but by the problems of implementing new systems while simultaneously trying to maintain the old systems. Vendors must take account of the conversion problems in their sales strategies.

E. PRODUCT AND SERVICE PERCEPTIONS

1. SOFTWARE

- Respondents were asked about their uses of the various types of products and services to determine their preferences and points of view. Their use of the product categories is summarized in Exhibit V-11.

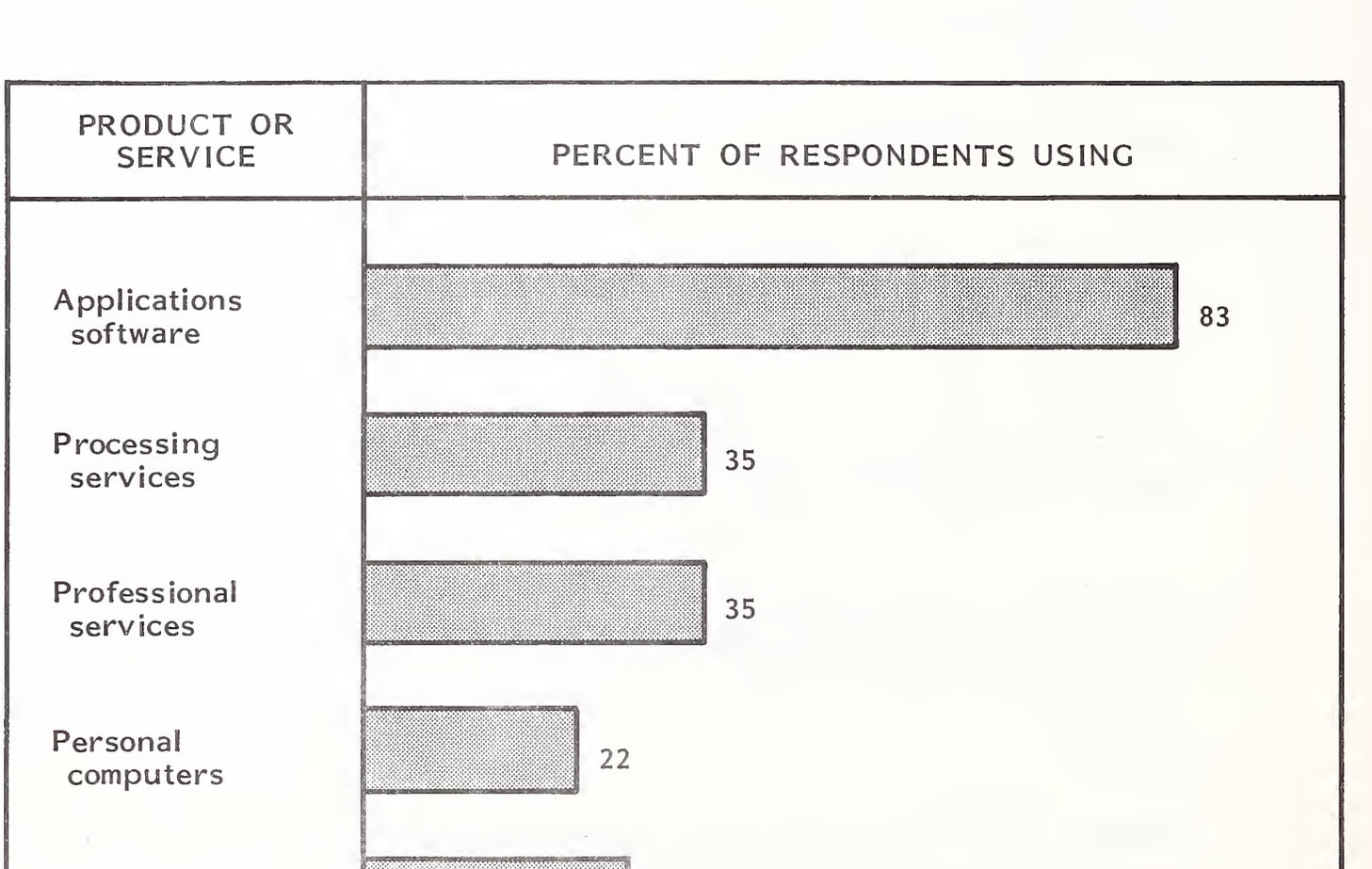
- Applications software packages were used by 83% of the respondents, most widely in the business area, followed by manufacturing. The only mention for engineering was BOM, with plans to implement finite element modeling by one respondent.

- Business software was concentrated in the A/R, A/P, and G/L applications. Payroll and fixed asset accounting packages were mentioned next, followed by a scattering of other financial applications.

- The software vendors for business applications in order of their frequency of mention are Management Science America (MSA), Software International, McCormack & Dodge, Fortex Manufacturing, Price Waterhouse, Lawson Associates, and Argonaut Information Systems. Arthur Andersen, Collier, Jackson & Associates, Data Design, Execucom Systems, IBM, and University Computing each received one mention.

EXHIBIT V-11

RESPONDENTS' USE OF PRODUCTS AND SERVICES



- Vendors for planned business area purchases were Collier, Jackson, Hewlett-Packard, Informatics, MSA, and Lawson Associates.

- Fifteen percent of the respondents listed full function manufacturing software packages including MRP, capacity requirements planning (CRP), master scheduling, inventory, and shop floor control. The other responses were scattered across a variety of manufacturing functions.

- Seventeen percent reported plans to install MRP systems.

- Manufacturing software vendors mentioned in order of frequency were IBM, Arthur Andersen, Honeywell, Atlantic Software, Benton Schneider, Burroughs, Cincom Systems, OIR, and Martin Marietta. Vendors for planned software were Hewlett-Packard, ASK, Cincom, Foresight Enterprises, Honeywell, and IBM.

- Respondents cited speed of implementation as the most important advantage in software packages. A lower cost than internally developed software was cited by 25% of the respondents.

- Proven code and vendor expertise or specialized skills were the next most frequently-mentioned advantages.

- Some advantages worth noting are:

  - Fixed cost to justify.

  - Lower overall risk.

  - No maintenance worries or responsibility.

  - Common software across all divisions.

- The MIS director of a very large fabricated metal company said, "My opinion has changed. Software packages are much more sophisticated and flexible now and more user-friendly. They cut EDP and programming costs to almost nothing. You don't have to spend thousands to modify them anymore."

- This respondent's comment conflicted with 60% of the others who cited the major disadvantage as having to modify packages because they may not exactly fit their needs.

- The need to modify was by far the most frequently mentioned disadvantage. There was little agreement on the other disadvantages mentioned which included difficulty of integration with existing systems, high initial cost, lack of flexibiliy, difficulty of modification, and the impact of modifications on new releases.

- Some users feared losing vendor support if they modified the packages. They cited other vendor-related disadvantages: poor maintenance, poor support, and dependence on the vendors' schedules for problem corrections, updates, and enhancements.

- Other users were concerned that application packages are too generally written to execute efficiently, resulting in very high overhead.

- The need for modification was the only disadvantage with a consensus of opinion; all other disadvantages are minor in comparison. In INPUT's opinion, users will be forced to relax their stance against modifications.

  - Programming resources are in short supply and hence more expensive.

  - Company finances are tight, while the needs to improve productivity and streamline operations is increasing.

- Users will become more willing to compromise on their system requirements and procedures and to accept a certain amount of inefficiency in the software packages.

- Vendors should concentrate on understanding users' needs and concerns. Part of this effort will involve accommodating reasonable needs for customization through modularity, coding books, and documentation.

- Vendors must insure that users' requests for modifications are driven by unique user requirements rather than nonstandard features/techniques or design shortcomings in their software.

2. PROCESSING SERVICES

- Thirty-five percent of respondents used processing services, most frequently in the business area. The only batch services being used were for payroll from ADP and local firms.

- Seventeen uses for remote computing services in 11 applications were mentioned for the business area. There were no concentrations, with applications mentioned in A/R, G/L, payroll, sales order entry, and billing.

- Three applications mentioned in the RCS area were not noted in either key in-house applications or software packages: project control and analysis, marketing analysis, and statistical analysis. These applications were reported in use by medium and very large companies.

- RCS vendors mentioned were ADP, CDC/SBC, XCS, Boeing Computer Services (BCS), Comshare, Chase/IDC, Martin Marietta, and Sun Information Services.

- Manufacturing is not so interested in processing services, with only 10 uses in seven application areas: NC, MRP, master scheduling, demand forecasting, coding and classification, inventory, and quality control. NC programming was the most frequently named application.

- Engineering uses were very light, including only BOM and general programming and engineering analysis (unspecified). Vendors used were Manufacturing Data Systems, Gould, CDC, Compuserv, University Computing, and XCS.

- These samples are probably not representative in that the respondents were mostly EDP managers while many users of RCS services are end users.

- Users were unanimous in their future plans for processing services: all wanted to eliminate it and bring the processing in-house.

- Every respondent listed cost as the major disadvantage. Loss of control was next, followed by concerns over vendor dependability.

- Loss of control, especially over costs, is a classic fear with RCS users and a difficult one for vendors to overcome. Fortunately, the advantages cited are still strong enough to overcome the objections:

  - Resources - more software, access to specialized applications, opportunity to try new applications, software and hardware kept current, and access to more powerful systems.

  - Flexibility - disaster backup, peak processing relief, one-time projects, fast acquisition of resources, and no scheduling.

  - Operating - no investment in hardware or software, no need to deal with systems, and better support and security.

- Twenty-one percent of the respondents were familiar with USHS, but none had systems installed, or any plans to install them.

- User opinions of USHS were mixed. Some felt they could get a better system for a lower cost, acquire a system more quickly, and reduce the technical support staffs at remote locations. Other respondents feared higher costs and inflexibility.

- One user considered USHS "No different than doing business with timesharing services. Just an old approach with a new name."

- Vendors offering USHS have not promoted their products to a large share of the market, nor have they made the benefits clear.

3. PROFESSIONAL SERVICES

- Thirty-five percent of the respondents are using professional services. All chose local or regional firms except one who was using Peat, Marwick, Mitchell & Co.

- Use by functional area was almost evenly divided. Half the user companies were medium and half very large.

- Expenditures for 1981 averaged $57,000 per user per year, with a range of $4,000 to $150,000. Expenditures for 1982 are expected to be approximately the same.

- The advantages cited most frequently were:

  - No long-term staff commitments (31%).

  - Faster startup and implementation (21%).

  - Availability of special expertise (19%).

- Not surprisingly, cost was the major disadvantage seen by respondents. Another major concern was that expertise would leave at the end of the project and maintenance could become a problem if the user were left with a code he was not familiar with.

- Respondents also expressed concern that they could not control the quality or the performance of the people assigned to them during the project.

- Despite the problems and rising costs, INPUT foresees a continued market for professional services due to a limited supply of technical people, sharply higher costs for them, and tight economic conditions.

4. INTEGRATED SYSTEMS

- Twenty-seven percent of the respondents had integrated systems installed, with six reporting multiple installations.

- Manufacturing and engineering accounted for 90% of the installations, with manufacturing showing the most diversity.

  - The engineering area reported all computer-aided design and drafting systems except for one pattern nesting system from Camsco. CAD system vendors were Auto-trol, CADAM, Computervision, MCAUTO, Nicolet, and Synercom Technology.

  - Manufacturing users reported integrated systems for production management, NC programming, CAD, distribution, and purchasing. Vendors included Computervision, Honeywell, MCAUTO, McCormack & Dodge, Univac, and University Computing.

- While engineering plans call for more CAD systems, manufacturing continues to diversify into shop floor data collection and job estimating systems, and production management and CAD systems.

- The advantages of integrated systems cited by users were fast implementation and startup, lower staff expenditures, no requirement for specialized in-house expertise, and less maintenance.

- While maintenance was cited as an advantage, it was also an area of concern. Some users feared dependency on the vendor, uncertain support if they modified the software, and general loss of control.

- Respondents most often complained that systems rarely fit their needs and required modifications. Close fit was primarily a concern of manufacturing, which is more procedure-bound than engineering.

- Integration difficulties were also mentioned often, with other comments such as "difficult to customize," "don't know what's in the code," and "lacks flexibility."

- Only two respondents cited cost as a disadvantage. Integrated systems are usually seen as a cost-effective means to a capability, even though users could usually save by procuring the hardware and software separately. Potential savings are not as important as single source, simplified procurement.

- Integrated systems vendors must begin addressing the applications integration issue since it is taking on more importance to the users.

5. PERSONAL COMPUTERS

- As price/performance continues to improve, computers are finding their way into many new applications and organizations.

- Since the use of personal computers or very small systems (under $15,000) is growing rapidly, INPUT has included them as an issue in this research to determine their impact on users and vendors.

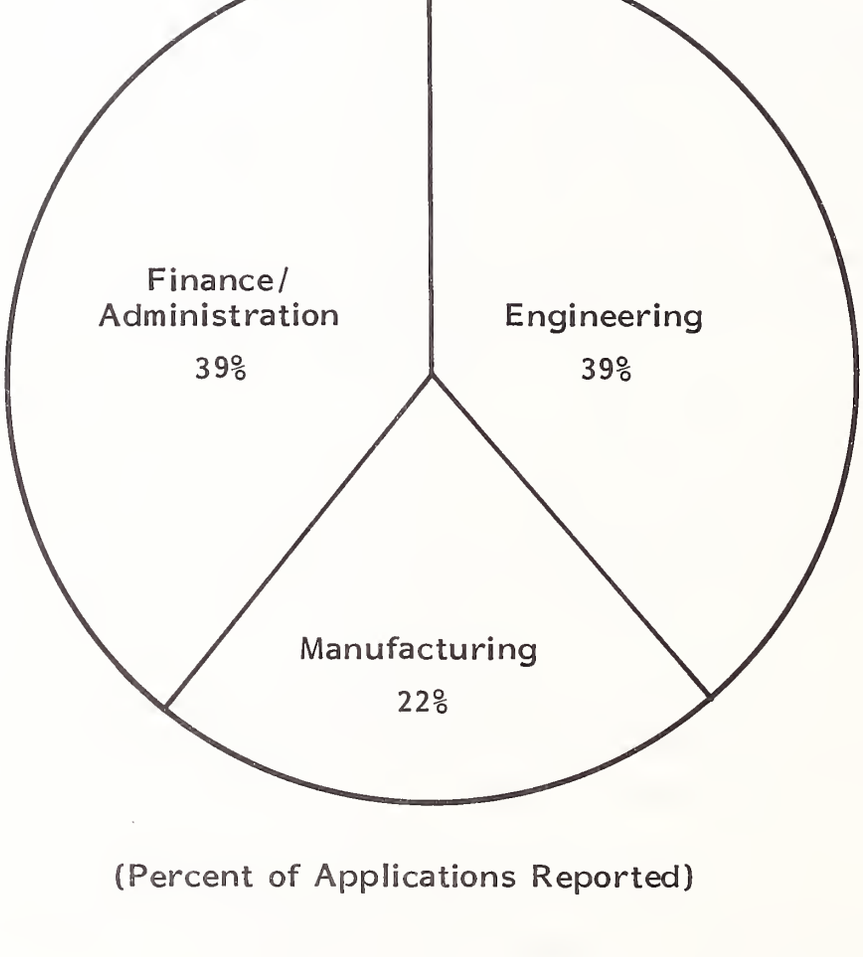
- Twenty-two percent of the respondents reported using personal computers. The use by organization is shown in Exhibit V-12.

  - The most frequent uses were for general engineering calculations, financial modeling and planning, and miscellaneous accounting and financial applications.

  - Other uses included order fulfillment, inventories, payroll, sales/marketing, quality control, general office, and word processing.

EXHIBIT V-12

USE OF PERSONAL COMPUTERS
BY FUNCTIONAL AREA



(Percent of Applications Reported)

NOTE: 36 applications reported by 22 respondents (42% of user respondents)

- No industry or organizational size correlations were detected in the user responses.

- Users considered the systems to be of moderate importance, giving them an average rating of 3.1 on a scale of 1 to 5, where 1 is not important and 5 is very important.

- Only five respondents had future plans for small systems in production scheduling, payroll, accounting, general office, and engineering.

- Many companies lack centralized control of the procurement of very small systems, which can be a problem as their popularity increases. As shown in Exhibit V-13, 60% of the small system user respondents reported either no control or decentralized procurements.

- Very small systems could be problems for both user companies and vendors of other products and services.

  - The proliferation of very small systems can hinder the development of a corporate information systems strategy and divert funds for corporate systems development.

  - On the other hand, small systems are freeing some users from the restrictions of the corporate MIS group.

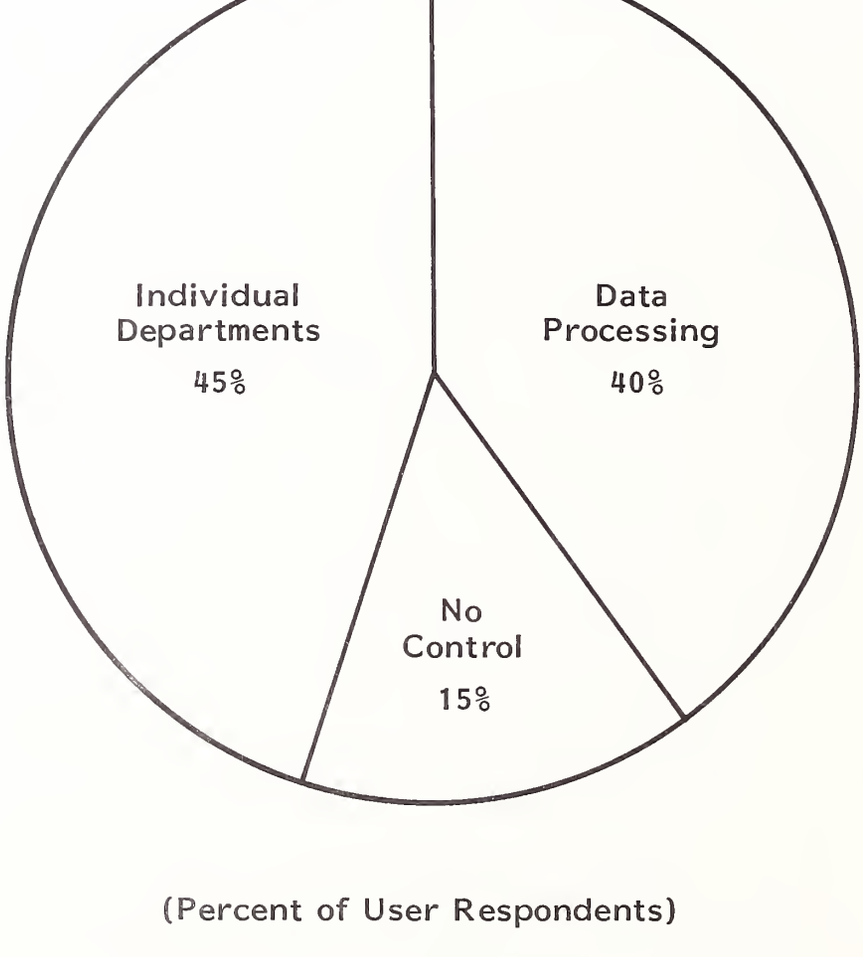
  - Corporations will have to begin controlling the procurement of very small systems to insure future systems compatibility and to avoid waste and duplication.

  - This centralization may work to the disadvantage of vendors by putting more areas under central control.

- Very small systems can be a mixed blessing to vendors:

EXHIBIT V-13

CONTROLLING ORGANIZATION FOR
PERSONAL COMPUTER PROCUREMENTS



(Percent of User Respondents)

- They help educate the users in the use of computers.

- They can delay sales of other products either by partially satisfying the requirements or diverting funds.

- They open a new market for software, professional services, and integrated systems vendors who can adjust to this cost-sensitive market.

- They can complicate sales efforts by introducing new requirements for systems to be integrated or accommodated.

- Very small systems will proliferate in all areas of manufacturing companies because of their convenience, independence, and low front-end costs. User companies and vendors will have to accept that fact and find ways to blend it into their plans.

F. PROBLEM AREAS

- When asked what their most significant problems were in developing and maintaining manufacturing systems, most respondents cited definition of requirements.

- Tied for second place were user training and education, users' lack of knowledge, and getting the users' involvement and cooperation.

- Generally, the comments directed at the users were harsh. These responses are skewed because of the large percentage of MIS/EDP manager respondents, but they do reveal communications problems among functions.

- Criticisms of users' knowledge, organization, and communications were not directed only at manufacturing, but at engineering and finance as well.

- Users have problems defining their requirements and communicating them to the DP organization for development.

- Some of the respondents' comments about the major problems are:

  - "Defining what they (users) want to do, what they really want to accomplish. You must rethink the philosophy of how you operate. It's an educational process."

  - "User involvement. Users never cooperate amongst themselves or approach MIS as a group. It is difficult to develop a complete system that will correspond to all their needs."

  - "Discipline. Getting (them) to understand and see what it takes to do the system the same way everywhere; otherwise it is not a computer function."

  - "Getting answers. Finding users who are educated . . . to see the impact of computers on manufacturing."

  - "Tough! EDP can solve all of their problems with BOM and MRP. Manufacturing would like to stick with their old way - they keep a lot of lists."

  - "Determining the needs and requirements of various groups. Each group is independent of the others. Getting a system to serve the needs of the company is very difficult."

  - "Getting user participation. Getting them to understand the importance of systems and then to fulfill their responsibilities."

  - "It is difficult to give them something when they don't know what they want."

- It sounds as if the users have no idea of what they need, when in fact they probably:

  - Do not have a full appreciation of what can be accomplished with a computer system.

  - Have difficulty articulating their needs to people who are not specialists in their discipline.

  - Have difficulty thinking objectively about how the application should be performed.

- This underscores an important issue for vendor consideration:

  - Users are typically not DP-oriented or experienced. Since they are ultimately the ones who must be satisfied with a vendor's product, vendors must learn to communicate with them in their own terms.

  - Vendors must also help to educate the users in how computers can be applied to their problems. This will be especially important in manufacturing because the level of computer knowledge is typically lower than in the engineering or business areas.

  - The technology issues are secondary to the application functions and benefits of the product or service. Vendors must become experts in the application area they are addressing if they hope to succeed.

VI VENDOR ISSUES

VI VENDOR ISSUES

A. OVERVIEW

- Vendors from a cross-section of company sizes and product types were interviewed for their opinions on industry issues, as shown in Exhibit VI-1.

- Since the issues were judgmental, no attempt was made to apply numerical measures or obtain statistical samples.

- Vendor company sizes ranged from very small to very large; product types covered a broad range, and company product sets ranged from single products to multiple products and services.

B. ENVIRONMENTAL FACTORS

1. CUSTOMER PROFILES

- Customer profiles were very broad for all but a few vendors.

- There was a wide range of company size for acceptable prospects with only two vendors stating that they would avoid companies of under $50 million in

EXHIBIT VI-1

VENDOR INTERVIEW PROFILE

COMPANY	FUNCTIONAL AREAS			DELIVERY MODES				
	Engineering	Manufacturing	Business	RCS	Batch Processing	Applications Software	Professional Services	Integrated Systems
ASK Computer Systems		X	X	X		X		X
American Software		X	X			X		
Boeing Computer Services	X	X	X	X		X	X	X
Cannon Computer Company		X			X	X		X
Computer Covenant		X	X			X		X
Comserv		X	X	X		X	X	
GEISCO	X	X	X	X	X	X	X	X
MCAUTO	X	X	X	X	X	X	X	X
Software International (owned by General Electric)		X	X			X		
University Computing Company	X	X	X	X	X	X		X

revenue. Although most vendors stated a size preference, they admitted flexibility in accepting clients.

- No strong preferences were stated for product types, geographic location, or industry. INPUT recommends that vendors define their market segments more precisely, and focus their efforts more narrowly.

2. MARKET FACTORS

- Vendors agreed that the manufacturing market has changed considerably in the last few years and will continue to change.

- A number of vendors felt that systems were becoming distributed and that the distributed philosophy was increasingly acceptable to MIS directors, especially in large companies.

- Several vendors stated that the manufacturing organization, ignored in the past, must now invest heavily to catch up with the other functional areas in computational capabilities. Users are also focusing on manufacturing systems to get more from their existing plant and equipment.

- Some vendors see a trend toward integration of all company functions, as businesses become more sophisticated and the companies realize that MRP and other manufacturing systems are important.

- One vendor senses an awareness that users are becoming sophisticated enough to see manufacturing applications as a business tool to run the company rather than just an inventory system.

- Respondents noted that data base vendors have emerged in the market recently to meet a need for more sophisticated systems and integration of functions.

- Other observations were:

- "More vendors entering the market. Everyone is talking about manufacturing systems, but there are still very few successful total systems."

- "More acceptance of software products and a decline in in-house development."

- "A trend to understanding that not everyone's requirements are unique is being aided by education and the cost and time for in-house developments."

- "Small companies, especially high-technology ones, are making the commitment early to get up on a computer."

- In the next five years, vendors foresee:

  - Continued trends toward integration, data base-oriented systems, and distributed systems.

  - Lower hardware costs facilitating USHS offerings by RCS vendors and a wider acceptance of remote services.

  - Demand for more MRP systems.

  - More emphasis on single vendor procurements such as integrated systems or multiple application purchases.

- One vendor saw that procedural languages for manufacturing systems could help avoid the customizing required with packaged applications.

- These views basically accord with the user responses, but there are troublesome factors in the user environment that vendors must address such as divided responsibilities for integration of applications, severe communications problems, and an imbalance between organizational need and budget control.

- Factors cited by the vendors are changing the computer services industry:

  - Users are becoming smarter, forcing vendors to do their homework and learn the business. This will also force greater vendor specialization.

  - Technology is impacting the industry with improved price/performance, smaller systems, graphics, and other product improvements. Technology is opening up new ways to offer products. The distribution of systems and systems functions and intelligence will keep the situation dynamic over the next several years.

  - The diverse requirements of users, especially in an integrated environment, are forcing vendors to become more consulting-oriented to be able to relate their products to the customers' needs and then tie them all together.

3. LEADING MARKET SEGMENTS AND PRODUCT OPPORTUNITIES

- Aerospace and transportation were the most frequently mentioned industry segments, followed by oil and gas equipment manufacturers and electronics. Others were high-technology firms and metalworking companies; two vendors listed "all" industries.

- The top product opportunities in order of frequency of mention were:

  - MRP.

  - CAD.

  - Manufacturing resources planning (a higher level implementation of MRP, integrated with other production management and financial applications).

- Integrated financials.

- CRP.

- The vendors were in accord when discussing market segments and product opportunities, but their opinions differed about future customer preferences for product delivery modes.

- The only item of strong agreement was the growing acceptance of integrated systems. The reasons given included users' becoming more sophisticated and less afraid of integrated systems, cheaper systems due to cheaper hardware, the desire to deal with one vendor, and the desire to stay away from the hardware selection and applications integration effort.

- Vendors also saw more interactive/on-line systems, more user-friendly systems, more professional services, increased need for data base applications and distributed data bases, and the need for heavier processing.

- The greatest disagreement concerned future customer preferences for RCS.

  - RCS were seen by some vendors as growing because:

    . RCS can act as a proof source for new users.

    . Since they limit a user's capital expenditures, they can be especially attractive to small, first-time users.

    . If USHS lightens communications costs RCS will be more attractive.

    . Increased use of computer aids will require heavier processing.

. Because hardware is becoming cheaper, RCS vendors' costs, and hence their prices, will drop, encouraging greater customer use.

- The last point, hardware cost decreases, was seen as the reason RCS usage declined, because there was an overwhelming user preference to go in-house.

. One vendor saw that manufacturing applications could be used in-house because they are mostly cycle costs as opposed to data transfer costs. RCS vendors have always had difficulty competing with in-house systems if they are just selling cycles.

- INPUT believes that there is merit in both views of the RCS situation, but they must be qualified by the product being offered on RCS and the customer profile.

- Hardware has improved steadily in price/performance since the early days of computing and has always been seen as a threat to RCS.

- Since user requirements always seem to outpace their capacity, a growing market for RCS is created. There is still a need for more capacity, so this situation should continue.

- RCS vendors have had to modify their offerings in the past to meet changing markets or respond to new technologies and this will be the case in manufacturing.

. Smaller firms and first-time users may become a significant share of the manufacturing RCS market.

. Unique software, such as data base systems or applications customized for narrow industry segments when tied to USHS, could allow vendors to target markets for success.

- While interactive, graphics-based design systems may not be cost effective on RCS for some time, if ever, CAD/USHS could use the hosts for large-scale analysis, CAE, or as data base and network managers in a powerful combination.

- Lower-cost hardware and the preference for on-site systems may not mean a decline for RCS, but rather a restructuring of products that recognize the need. RCS vendors should offer USHS to meet this preference.

- If RCS vendors do not have the flexibility to develop product differentiation through specialization, they will find themselves closed out of the discrete manufacturing market, or forced to compete on a heavily discounted price basis.

4. VENDOR PRODUCT CHANGES

- Most vendor plans appeared to be conservative, reflecting uncertainty over where the market is going. Some of the plans included changing from software to integrated systems, converting systems to on-line operation, downsizing software to minis, and converting to different mainframes.

- Some of the vendors, more bullish in their planning, are going to offer USHS, integrated CAD and CAM systems, and fully integrated CAD/CAM and financial systems.

- Competing effectively in the manufacturing market now and in the future will depend more on the vendors' knowledge of the applications than on product delivery modes or technology.

- Many prospective customers hesitate to buy information systems products because they lack the knowlege, information, and guidance to properly evaluate their position and confidently decide on a course of action. This will change as the market gains more sophistication, but that time is still several years off.

5. COMPETITION

- Competition is heightening in this market not so much because of new vendor entries, but rather because existing vendors are adding resources and intensifying their efforts.

- When vendors were asked to list their top four competitors, they named the top vendors in software, RCS, and integrated systems.

  - Only six vendors received multiple mentions, with IBM receiving the most. Hewlett-Packard and ASK were ranked second and Comserv, CDC, and MCAUTO third.

  - Applicon, Arista, BCS, Cincom, Computervision, Cullinane Database Systems, GEISCO, Martin Marietta, United Computing, and XCS were also mentioned.

- The most perceptive may have been the vendors who listed "doing nothing" and "local vendors" as top competitors.

  - Of the hundreds of companies selling software packages to the discrete manufacturing sector, fewer than 20 have revenue exceeding $10 million per year from these sales. The same is true for processing services.

  - No vendors stand out with a solid, commanding lead in this market sector except ADP and CDC/SBC in batch services.

  - Local or very small vendors are making an impact on the market today and will continue to do so until a greater market share and more leadership are concentrated among a smaller number of vendors.

6. MAJOR PROBLEMS

- Perceived unique requirements and limited user knowledge were the major problems most vendors cited.

- Failure to keep good records, lack of discipline, and similar problems cited by the MIS directors were echoed by the vendors. Since both parties have much to gain from a better educated, more cooperative user, they should devise solutions to the problems as soon as possible. This problem is as important as technology or any other issue.

- A leading integrated systems vendor listed identifying and reaching the market as his top problem.

  - This problem will only increase as users, technologies, and other factors develop.

  - Vendors should regularly examine strategies and tactics to be sure they are in tune with the market.

- A leading multiple product vendor listed as one of his top problems uncertainty that CAD/CAM systems may have a slowing effect on decision cycles. Confusion in all areas of manufacturing applications, integration, product delivery mode advantages, and other areas unfamiliar to many users will slow decision cycles; again, education is the key.

C. SELECTED ISSUES

- Four issues were selected for discussion with the vendors because they could have a timely and important impact on this market.

I. INTEGRATION

- The vendors' opinions of the need for and importance of applications integration varied about as widely as the users'. Their opinion of the severity of impact ranged from none to major.

- Some vendors saw no strong need for integrating systems in the various functional areas:

  - "May not be worth doing." - leading integrated systems vendor.

  - "No tremendous need now. Would be better to put the effort into expansion of the business software so they can make better decisions." - leading integrated systems vendor.

  - "No pressure now - in five years - will happen through joint CAD and CAM company ventures." - leading software and services vendor.

- Other vendors saw a need and were working on the problem or had solved it:

  - "No problem - we're doing it now." - small software vendor.

  - "Working on it now." - large multiple products vendor.

  - "Interface can be easily written - no big problem." - leading software vendor.

- One large multiple products vendor stated, "CAD and CAM vendors don't really know what is required." From the other responses, he may be right.

- Integration is a complex and highly individualized issue, depending on the users' requirements and systems and the vendors' products and capabilities.

- The one group certain to profit from the integration issue is the professional services companies.

- The definition of integration and a clearer look at the problem will have to wait until the market matures further.

2. IBM

- Over half the vendor respondents did not expect IBM's reentry into the RCS business after a long absence to have any impact on their efforts. Two said it was still too early to tell. One of them felt it would be positive, expanding the market for all by putting a blessing on services.

- One large multiple products vendor felt that IBM could be successful and even formidable if it continued to invest in manufacturing. He felt that IBM was still "iron-oriented" and that it needed to get more involved in the support side.

- A large services vendor was waiting to see, but thought IBM could have an impact on all vendors. He was not overly concerned because it was not a significant software supplier and it would need an inventory of software to succeed in services.

- In INPUT's opinion, IBM should not be taken lightly if it targets manufacturing with its RCS.

  - It has succeeded in selling CAD systems and is aggressively building its product set and support organization.

  - It has a broad installed base of manufacturing software packages such as MAPICS and COPICS. Critics will fault its implementation success rate with these packages, but no one can deny its massive presence in this market.

- Its recent announcement of a line of robotics products should make it very clear that IBM is serious about the manufacturing market.

3. USER SITE HARDWARE SERVICES

- This issue also received mixed responses. Even the RCS vendors had different opinions of its viability.

  - "Very positive. Opens up new vendor opportunities and meets needs of users as they become more sophisticated."

  - "A rearguard defensive measure to keep RCS revenues going."

  - "Possibly viable for some manufacturing applications if analytical as opposed to transaction-oriented."

  - "Doing some now. Not sure about effectiveness in manufacturing. Being driven by the defensiveness of vendors."

- There is no reason why USHS cannot be as successful in discrete manufacturing applications as in others, if the industry matures and user needs and vendors product capabilities are better defined. It may be five years before USHS finds a sizable market in this industry.

4. PERSONAL COMPUTERS

- Personal computers or very small systems (under $15,000 purchase price) were included as an issue because of their rapid proliferation in all sizes and types of companies.

- All but two vendors saw an impact on the market and their efforts. One saw no short-term impact, but was looking at it.

- Three vendors regarded small systems as positive because they would develop upgrade prospects. Two of them also considered the systems vehicles for educating the users.

- A leading integrated systems vendor feared that users might outgrow their small system applications and then resist change during the upgrade process.

- A large RCS vendor saw small systems as an opportunity to create distributed systems and treat them as USHS by tying them into the network.

- The ease of procuring small systems concerns all vendors. The trend may not directly block business opportunities, but it can complicate them.

- This is another issue which will benefit only one vendor group: professional services.

APPENDIX A: DEFINITIONS

APPENDIX A: DEFINITIONS

COMPUTER SERVICES

- These are services provided by vendors which perform data processing (DP) functions using vendors' computers (processing services) or assist users to perform such functions on their own computers (software products and/or professional services).

- The following are definitions of the modes of service used in this report.

  - Remote Computing Services (RCS) provide DP to a user by means of terminals at the user's site(s) connected by a data communications network to the vendor's central computer. There are five submodes of RCS:

    . Interactive (timesharing) is characterized by the interaction of the user with the system, primarily for problem-solving time-sharing but also for data entry and transaction processing: the user is on-line to the program/files.

    . Remote Batch is where the user hands over control of a job to the vendor's computer, which schedules job execution according to priorities and resource requirements.

- Data Base is characterized by the retrieval and processing of information from a vendor-maintained data base. The data base may be owned by the vendor or a third party.

- User Site Hardware Services (USHS). These offerings provided by RCS vendors place programmable hardware on the user's site (rather than the EDP center). USHS offers:

  - Access to a communications network.

  - Access through the network to the RCS vendor's larger computers.

  - Significant software as part of the service.

- Videotext is a variant of interactive RCS.

  - Access may be through cable television systems as well as ordinary telephone lines.

  - The display is a television set equipped with a keypad or typewriter keyboard and special circuitry.

  - The user may not create programs on the remote computer.

  - The user may query or enter transactions to the remote computer through menu-driven software.

  - Prestel and QUBE are examples of videotext.

- Batch Services include DP performed at vendors' sites of user programs and/or data which are physically transported (as opposed to electronically, by telecommunications media) to and/or from those sites. Data

entry and data output services, such as keypunching and Computer Output Microfilm processing, are also included. Batch services include those expenditures by users who take their data to a vendor's site, where a terminal connected to a remote computer is used for the actual processing.

- Processing Services Facilities Management (FM). (Also referred to as "Resource Management" or "Systems Management.") The management of all or a significant part of a user's DP functions under a long-term contract (not less than one year). To qualify as processing services FM, the contractor must directly plan and control as well as operate its own computers/communications network, including providing computers at the client's site, to deliver the service. Simply providing resources, even though under a long-term contract, and/or providing for all of a user's processing needs, does not necessarily qualify as FM.

TYPES OF PROCESSING SERVICES

- Processing services encompass processing services (FM, RCS, and batch services. They are categorized by type of services bought by users as follows:

  - Function-Specific services are the processing of applications that are targeted to specific user departments (e.g., finance, personnel, sales) but cut across industry lines. Most general ledger, accounts receivable, payroll and personnel applications fall into this category. General purpose tools such as financial planning systems, linear regression packages and other statistical routines are also included in this category. However, when the application or tool is designed for specific industry usage, then the service is industry-specific.

  - Industry-Specific services provide processing for particular functions or problems unique to an industry or industry group. The software is

provided by the vendor either as a complete package or as an applications "tool" which the user employs to produce a unique solution. Specialty applications can be either business or scientific in orientation; data base services, where the vendor supplies the data base and controls access to it (although it may be owned by a third party), are also included under this category. Examples of industry specialty applications are: seismic data processing, numerically controlled machine tool software development, and demand deposit accounting.

- Utility services are those where the vendor provides access to a computer and/or communications network with basic software that enables any user to develop its own problem solution or processing system. These basic tools include terminal-handling software, sorts, language compilers, data base management systems, information retrieval software, scientific library routines, and other systems software.

USE OF PROCESSING SERVICES

- Processing can be categorized by use as follows:

  - Transaction Processing indicates those services where the primary or predominant purpose of the application is to process transactions, usually in a highly repetitive fashion. Most business accounting fits into this category. Payroll, accounts receivable, order entry, portfolio accounting, and inventory control are all good examples of transaction processing.

  - Information Analysis services are processing services where the primary or predominant purpose of the application is to convert data into information through the use of mathematical, statistical, or financial analysis tools that readily and easily display the results in report or

graphical form. The tools may be rapidly adapted to address a variety of nonrepetitive problems. These tools are often in the areas of financial analysis, marketing, planning, and statistical analysis. Many of the techniques incorporated have their origins in scientific and engineering applications, which also generally fall within this category.

- User Data Base Management servies are processing services where the primary or predominant purpose of the application is to organize and maintain a data base of user information in a manner that facilitates its rapid and efficient retrieval and display according to user-defined parameters, either in ad hoc or fixed form.

- Vendor Data Base services are processing services where the primary or predominant purpose of the application is to retrieve and/or process data supplied by the vendor who controls access to it (although it may be owned by a third party). There are two modes of delivery of this service:

  . Inquiry data base services provide a means of selection and retrieval of data only. They neither provide, nor usually allow, for the subsequent processing of the data. Stock market statistics, news services, and bibliographic data bases are commonly offered in this mode.

  . Application Processing services, in addition to providing a means of selection and retrieval, also provide a means of further processing the data into information through the full use of information analysis tools and data base management systems, which permit the merging of vendor data with user data. Demographic, marketing, and financial and economic data bases are commonly offered in this mode.

PROFESSIONAL SERVICES

- This category is made up of services related to EDP, including professional services FM, system design, custom/contract programming, consulting, education, and training. Services are provided on the basis of:

  - Time and Materials - The billing rate is measured in units of time, rather than actual costs.

  - Fixed Price - A firm price is agreed upon for a defined piece of work.

  - Cost Plus Fee - The billing rate depends on actual costs plus a fixed fee.

- Professional Services Facilities Management (FM) is the management of all or a significant part of a user's DP functions under a long-term contract (not less than one year). To qualify as professional services FM, the contractor must directly plan and control as well as operate the client's facility, where the computers are owned by the client. Simply providing resources, even though under a long-term contract, does not necessarily qualify as professional services FM.

SOFTWARE PRODUCTS

- This category includes the user's purchase of applications and systems packages for use on in-house computer systems. Included are lease and purchase expenditures as well as fees for work performed by the vendor to implement and maintain the package at the user's site(s). Fees for work performed by organizations other than the package vendor are counted in professional services. There are several subcategories of software products:

- Applications Products are software products which perform processing to serve user functions. They consist of:

  - Cross-industry products, which are used in multiple-user industry sectors. Examples are payroll, inventory control, and financial planning.

  - Industry-specialized products, which are used in a specific industry sector such as banking and finance, transportation, or discrete manufacturing. Examples are demand deposit accounting and airline scheduling.

- Systems Products are software products which enable the computer/communications system to perform basic functions. They consist of:

  - Systems operations products, which function during applications program execution to manage the computer system resource. Examples include operating systems, communication monitors, emulators, and spoolers.

  - Systems utilization products, used by operations personnel to utilize the computer system more effectively. Examples include performance measurement, job accounting, computer operations scheduling, and utilities.

  - Systems implementation products, used to prepare applications for execution by assisting in designing, programming, testing and related functions. Examples include languages, sorts, productivity aids, data dictionaries, report writers, project control systems, retrieval systems, and data base management systems.

INTEGRATED SYSTEMS (TURNKEY)

- An integration of systems and applications software with hardware, packaged as a single entity. The value added by the vendor is primarily in the software.
  - Most CAD/CAM systems and many small business systems are integrated systems. This does not include specialized hardware systems such as word processors, cash registers, process control systems, and military weapon systems.
  - Products sold by companies which are primarily computer manufacturers are generally excluded.

TELETEXT

- Teletext is an information service that is distinct from processing services.
  - Information is provided to the user through a broadcast transmission.
  - The vendor does not process user data.
  - Information may be selectively displayed through interaction with the receiver, not the vendor's computer.
  - The receiver is usually a television set equipped with special circuitry and sometimes a device which allows the user to select which portion of the broadcast should be displayed. There are two types of service:
    - Continuous. Transmission is continuous. The user cannot select information to be displayed.

. Selective. The user can select a portion of the transmission to be displayed.

- Examples of teletext include cable TV broadcast of news services and stock quotations.

OTHER CONSIDERATIONS

- All expenditures and revenue addressed are "available" in that they are open for competition. "Captive" figures, which refer to expenditures by a user for services from a subsidiary company, such as Boeing Aircraft with Boeing Computer Services (BCS), are not included. They may be referred to when examining an individual "spin-off" vendor, such as BCS.

- When any questions arise as to the proper place to count certain user expenditures, INPUT addresses the questions from the user viewpoint and categorizes the expenditures according to the answer to the question, "What do the users perceive they are buying?"

- Industry sectors used in this report are defined in Exhibit A-1.

MANUFACTURING-SPECIFIC DEFINITIONS

- BILL OF MATERIAL (BOM). A listing of all subassemblies, parts, and materials that go into an assembled part showing the quantities of each.

- CAD (Computer-Aided Design). Applications of computer and graphic technology to engineering, design, and drafting.

- CAD/CAM. The integrated applications of CAD and CAM.

EXHIBIT A-1

INDUSTRY SECTOR DEFINITIONS

INDUSTRY SECTOR	INDUSTRY SIC	INDUSTRY NAME
DISCRETE MANUFACTURING	23	APPAREL
	25	FURNITURE
	27	PRINTING
	31	LEATHER
	34	METAL
	35	MACHINERY
	36	ELECTRONICS
	37	TRANSPORTATION
	38	SCIENTIFIC AND CONTROL INSTRUMENTS
	39	MISCELLANEOUS MFG.
PROCESS MANUFACTURING	10	METAL MINING
	11	ANTHRACITE MINING
	12	COAL MINING
	13	OIL AND GAS EXTRACTION
	20	FOOD PRODUCTS
	21	TOBACCO
	22	TEXTILE PRODUCTS
	24	LUMBER AND WOOD PRODUCTS
	26	PAPER PRODUCTS
	28	CHEMICALS
	29	PETROLEUM
	30	RUBBER AND PLASTICS
	32	STONE, GLASS, CLAY
	33	PRIMARY METALS

EXHIBIT A-1 (Cont.)

INDUSTRY SECTOR DEFINITIONS

INDUSTRY SECTOR	INDUSTRY SIC	INDUSTRY NAME
TRANSPORTATION	40	RAILROADS
	41	LOCAL TRANSIT
	42	MOTOR FREIGHT
	43	U.S. POSTAL SERVICE
	44	WATER TRANSPORTATION
	45	AIR
	46	PIPELINES
	47	TRANSPORTATION SERVICES
UTILITIES	48	COMMUNICATIONS
	49	ELECTRIC, GAS, & SANITARY
BANKING AND FINANCE	60	BANKS
	61	CREDIT AGENCIES
	62	SECURITY AND COMMODITY BROKERS
	67	HOLDING AND INVESTMENT OFFICES
INSURANCE	63	INSURANCE (LIFE, HEALTH, ETC.)
	64	INSURANCE AGENTS
MEDICAL	80	HEALTH SERVICES

EXHIBIT A-1 (Cont.)

INDUSTRY SECTOR DEFINITIONS

INDUSTRY SECTOR	INDUSTRY SIC	INDUSTRY NAME
EDUCATION	82	EDUCATIONAL SERVICES
RETAIL	52	BUILDING MATERIALS, HARDWARE
	53	GENERAL MERCHANDISE
	54	FOOD
	55	AUTOMOTIVE AND GAS STATIONS
	56	APPAREL
	57	FURNITURE
	58	EATING AND DRINKING
	59	MISCELLANEOUS RETAIL
WHOLESALE	50	DURABLE GOODS
	51	NON-DURABLE GOODS
STATE AND LOCAL GOVERNMENT	91-97	AS APPROPRIATE
FEDERAL GOVERNMENT	91-97	AS APPROPRIATE
SERVICES	73	BUSINESS SERVICES

EXHIBIT A-1 (Cont.)

INDUSTRY SECTOR DEFINITIONS

INDUSTRY SECTOR	INDUSTRY SIC	INDUSTRY NAME
OTHER INDUSTRIES	01-09	AGRICULTURE, FORESTRY, AND FISHING
	15-17	CONSTRUCTION
	65	REAL ESTATE
	66	COMBINATIONS OF REAL ESTATE, INSURANCE, LOANS, LAW OFFICES
	70	HOTELS, ROOMING HOUSES, CAMPS, AND OTHER LODGING PLACES
	72	PERSONAL SERVICES
	75	AUTOMOTIVE REPAIR, SERVICES, AND GARAGES
	76	MISCELLANEOUS REPAIR SERVICES
	78	MOTION PICTURES
	79	AMUSEMENT AND RECREATION SERVICES, EXCEPT MOTION PICTURES
	83	SOCIAL SERVICES
	84	MUSEUMS, ART GALLERIES, BOTANICAL AND ZOOLOGICAL GARDENS
	86	MEMBERSHIP ORGANIZATIONS
	89	MISCELLANEOUS SERVICES

- CAM (Computer-Aided Manufacturing). Application of computer and graphic technology to manufacturing engineering, planning, and control.

- CAPACITY REQUIREMENTS PLANNING. The translation of open shop orders and planned shop orders into hours of work by time period and work center.

- COMPUTER-AIDED ENGINEERING. The use of a full range of software and systems to model, simulate, and analyze a product before construction of production models.

- FINITE ELEMENT ANALYSIS. As used in this report, this includes all tasks involved in structural analysis using finite element methods: mesh generation, preprocessing, finite element analysis processing, and post-processing.

- GROUP TECHNOLOGY. The application of classification and coding technology to search a data base for information on similar parts and to apply this to CAD and CAM tasks.

- MANUFACTURING RESOURCE PLANNING. An extension of MRP where MRP is integrated with financial planning, a simulation capability, and other functions on a closed loop basis for the planning of all of the resources of a manufacturing company.

- MASTER PRODUCTION SCHEDULE. An anticipated build schedule that drives the MRP system.

- MATERIAL REQUIREMENTS PLANNING (MRP). A system to calculate material requirements on a time phases basis from inputs from BOM, inventory status, open order status, and master production schedules.

- NESTING. Software to automatically or interactively arrange patterns for parts within stock material boundaries.

- NUMERICAL CONTROL (NC). CAM technology and systems for generating numerically controlled machine tool programs.

- SHIPMENTS. The dollar equivalent of products shipped by a manufacturing establishment. Will usually be approximately equal to annual revenue.

- SHOP FLOOR CONTROL. Control of the progress of each customer order or stock order through the operations of its production cycle and the collection of data about actual completion results or status.

- VALUE ADDED. The portion of product shipment values originating in that industry; includes factors such as labor costs, depreciation, various business expenses, and energy costs. It is basically the difference between shipments and raw or input materials costs.

OTHER DEFINITIONS

- DATA BASE MANAGEMENT SYSTEM (DBMS). A software system that allows a user to structure a data base by defining the data, its organization, and the association between data elements. It also includes a data manipulation language (for access, sorting, merging, etc.) and controls for concurrent use (security, request, queuing, etc.). Functions as a common interface to multiple applications.

- DISTRIBUTED DATA BASE. A data base which is physically located at multiple sites, with each site having a part of the total data base. The sites are usually linked to a central site as well as having access to each other.

- DISTRIBUTED PROCESSING. Multiple computers simultaneously processing elements of a CAD or CAM task.

- MANAGEMENT INFORMATION SYSTEM (MIS). A DP system specifically designed to provide business managers with company, financial, project, or program data.

- NETWORKING. The interconnection and control of remotely located systems and devices over communications lines.

APPENDIX B: DATA BASE

EXHIBIT B-1

LARGEST DISCRETE MANUFACTURING SUBSECTORS - SHIPMENTS

RANK	SIC	INDUSTRY SUBSECTOR	SHIPMENTS ($ billions)	PERCENT OF TOTAL DISCRETE MANUF.
1	371	Motor vehicles and equipment	$131.4	15.6%
2	372	Aircraft and parts	39.4	4.7
3	344	Fabricated structural metal	32.2	3.8
4	353	Construction and related machinery	31.5	3.7
5	366	Communication equipment	30.3	3.6
6	357	Office and computing machines	26.6	3.2
7	367	Electronic components	22.7	2.7
8	346	Metal forgings and stamping	21.7	2.6
9	356	General industrial machinery	21.7	2.6
10	349	Miscellaneous fabricated metal products	19.1	2.3
TOTAL			$376.6	44.8%

Note: Excludes newspapers (SIC 2711) and commercial printing (SIC 275).

EXHIBIT B-2

LARGEST DISCRETE MANUFACTURING SUBSECTORS - VALUE ADDED

RANK	SIC	INDUSTRY SUBSECTOR	VALUE ADDED ($ billions)	PERCENT OF TOTAL DISCRETE MANUF.
1	371	Motor vehicles and equipment	$41.2	9.5%
2	372	Aircraft and parts	22.9	5.3
3	366	Communication equipment	18.9	4.4
4	353	Construction and related machinery	16.3	3.8
5	357	Office and computing machines	15.6	3.6
6	344	Fabricated structural metal	14.7	3.4
7	367	Electronic components	14.2	3.3
8	356	General industrial machinery	12.5	2.9
9	354	Metalworking machinery	12.2	2.8
10	346	Metal forgings and stampings	10.4	2.4
TOTAL			$178.9	41.4%

NOTE: May not total due to rounding.

EXHIBIT B-3

ESTABLISHMENTS PER EMPLOYEE SIZE CLASS

SIC	DESCRIPTION	TOTAL ESTABLISH-MENTS	EMPLOYEES								
			1-49	50-99	100-249	250-499	500-999	1,000-1,499	1,500-2,499	2,500-4,999	>5,000
23	Apparel	22,554									
	Establishments		16,133	3,007	2,346	836	194	22	11	4	1
	Percent		71.5%	13.3%	10.4%	3.7%	0.9%	0.1%	0.05%	0.02%	-
	Cum. (percent)		71.5	84.8	95.2	98.9	99.8	99.9	-	-	100%
25	Furniture	8,904									
	Establishments		6,831	922	716	292	114	15	12	1	1
	Percent		76.7%	10.4%	8.0%	3.3%	1.3%	0.2%	0.1%	-	-
	Cum. (percent)		76.7	87.1	95.1	98.4	99.7	99.9	-	-	100%
27	Printing/publishing	44,415									
	Establishments		39,917	2,372	1,406	423	188	57	33	16	3
	Percent		89.9%	5.3%	3.2%	1.0%	0.4%	0.1%	0.07%	0.04%	-
	Cum. (percent)		89.9	95.2	98.4	99.4	99.8	99.9	-	-	100%
30	Rubber & plastics	11,747									
	Establishments		8,358	1,542	1,236	414	113	36	34	11	3
	Percent		71.2%	13.1%	10.5%	3.5%	1.0%	0.3%	0.3%	0.09%	-
	Cum. (percent)		71.2	84.3	94.8	98.3	99.3	99.6	99.9	-	100%

CONTINUED

EXHIBIT B-3 (Cont.)

ESTABLISHMENTS PER EMPLOYEE SIZE CLASS

SIC	DESCRIPTION	TOTAL ESTABLISH-MENTS	EMPLOYEES								
			1-49	50-99	100-249	250-499	500-999	1,000-1,499	1,500-2,499	2,500-4,999	>5,000
31	Leather	2,671									
	Establishments		1,703	314	346	258	41	6	2	1	0
	Percent		63.8%	11.8%	13.0%	9.7%	1.5%	0.2%	0.07%	-	-
	Cum. (percent)		63.8	75.6	88.6	98.3	99.8	-	-	-	100%
34	Fabricated metal	30,901									
	Establishments		23,968	3,341	2,334	831	296	58	37	35	1
	Percent		77.6%	10.8%	7.6%	2.7%	1.0%	0.2%	0.1%	0.1%	-
	Cum. (percent)		77.6	88.4	96.0	98.7	99.7	99.9	-	-	100%
35	Machinery	45,322									
	Establishments		38,441	3,034	2,095	899	507	165	100	57	24
	Percent		84.8%	6.7%	4.6%	2.0%	1.1%	0.4%	0.2%	0.1%	-
	Cum. (percent)		84.8	91.5	96.1	98.1	99.2	99.6	99.8	99.9	100%
36	Electrical/electronic	13,538									
	Establishments		8,790	1,478	1,620	806	486	152	103	72	31
	Percent		64.9%	10.9%	12.0%	6.0%	3.6%	1.1%	0.8%	0.5%	0.2%
	Cum. (percent)		64.9	75.8	87.8	93.8	97.4	98.5	99.3	99.8	100%

CONTINUED

EXHIBIT B-3 (Cont.)

ESTABLISHMENTS PER EMPLOYEE SIZE CLASS

SIC	DESCRIPTION	TOTAL ESTABLISH-MENTS	EMPLOYEES								
			1-49	50-99	100-249	250-499	500-999	1,000-1,499	1,500-2,499	2,500-4,999	>5,000
37	Transportation	8,661									
	Establishments		6,021	895	779	424	222	81	68	82	89
	Percent		69.5%	10.3%	9.0%	4.9%	2.6%	1.0%	0.8%	1.0%	1.0%
	Cum. (percent)		69.5	79.8	88.8	93.7	96.3	97.3	98.1	99.1	100%
38	Instruments	6,921									
	Establishments		5,245	609	555	275	146	48	21	14	8
	Percent		75.8%	8.8%	8.0%	4.0%	2.1%	0.7%	0.3%	0.2%	0.1%
	Cum. (percent)		75.8	84.6	92.6	96.6	98.7	99.4	99.7	99.9	100%
39	Miscellaneous	13,743									
	Establishments		11,918	917	592	213	77	17	8	1	0
	Percent		86.7%	6.7%	4.3%	1.5%	0.6%	0.6%	0.1%	0.06%	-
	Cum. (percent)		86.7	93.4	97.7	99.2	99.8	99.9	-	-	100%
	TOTAL	209,377	167,325	-	14,025	5,671	2,384	657	-	-	-
			79.9%	8.8%	6.7%	2.7%	1.1%	0.3%	-	-	-
			79.9	88.7	95.4	98.1	99.2	98.5	-	-	-

EXHIBIT B-4

DISTRIBUTION OF ESTABLISHMENTS BY SHIPMENTS

SIC	SMALL (< $25 million)	MEDIUM ($25-99 million)	LARGE ($100-249 million)	VERY LARGE (> $250 million)
23	22,472* (99.6%)†	79*	3*	0
25	8,830 (99.2)	72	2	0
27	44,118 (99.3)	271	23	3*
30	11,494 (97.8)	228 (1.9%)†	20	5
31	2,648 (99.1)	22	1	0
34	30,273 (98.0)	555 (1.8)	63	10
35	44,235 (97.6)	906 (2.0)	142	39
36	12,571 (92.9)	831 (6.1)	94	42
37	7,695 (88.8)	646 (7.5)	149 (1.7%)†	171 (2.0%)†
38	6,639 (95.9)	253 (3.7)	19	10
39	13,640 (99.3)	95	8	0
TOTAL	204,615 (97.7%)	3,958 (1.9%)	524 (0.3%)	280 (0.1%)

* Number of establishments
†Percent of SIC total

EXHIBIT B-5

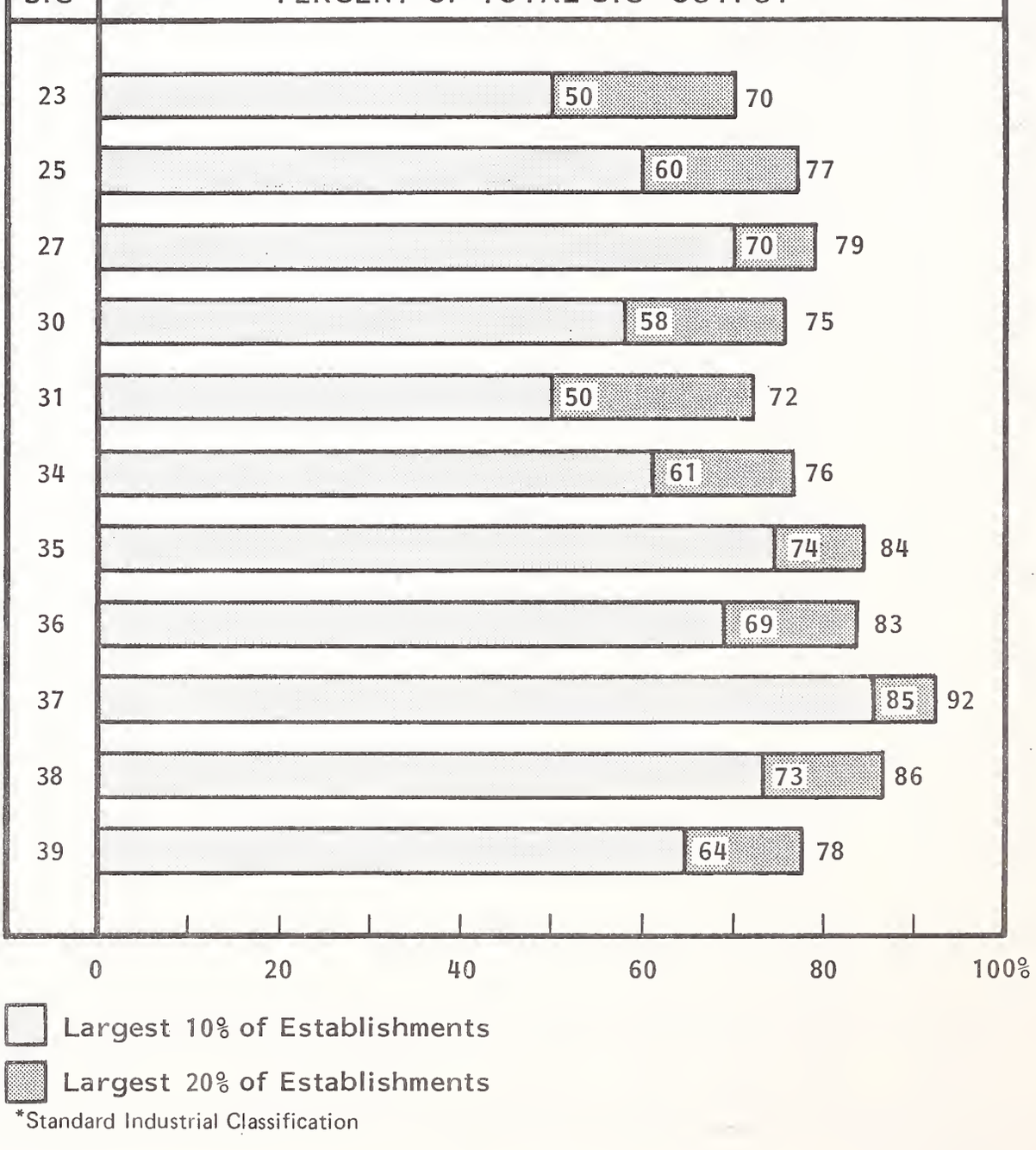
DISTRIBUTION OF ESTABLISHMENTS BY VALUE ADDED

SIC	SMALL (< $15 million)	MEDIUM ($15-49 million)	LARGE ($50-149 million)	VERY LARGE (> $150 million)
23	22,501* (99.8%)†	50*	3*	0
25	8,840 (99.3)	61	3	0
27	44,089 (99.3)	295	27	4*
30	11,609 (98.8)	114 (1.0%)†	21	3
31	2,656 (99.4)	14	1	0
34	30,398 (98.4)	430 (1.4)	69	4
35	44,287 (97.7)	835 (1.8)	164	36
36	12,603 (93.1)	729 (5.4)	167 (1.2%)†	39
37	8,011 (92.5)	397 (4.6)	143 (1.7)	110 (1.2%)†
38	6,621 (95.7)	250 (3.6)	39	11
39	13,684 (99.6)	56	3	0
TOTAL	205,299 (98.1%)	3,231 (1.5%)	640 (0.3%)	207 (0.1%)

*Number of establishments
†Percent of SIC total

EXHIBIT B-6

DISTRIBUTION OF TOTAL OUTPUT AMONG LARGEST ESTABLISHMENTS



*Standard Industrial Classification

EXHIBIT B-7

DISCRETE MANUFACTURING EXPENDITURES
(percent of shipments)

SIC*	MATERIALS	LABOR	END-OF-YEAR INVENTORIES	NEW CAPITAL EXPENDITURES
23	50%	25%	14%	1.2%
25	49	26	16	2.5
27	36	27	8	8
30	52	22	13	5
31	53	23	15	1.4
34	51	23	17	3
35	47	24	22	4
36	45	25	19	4
37	62	19	15	3
38	37	25	20	4
39	49	22	19	3

* Standard Industrial Classification

EXHIBIT B-8

PROCESSING FACILITIES MANAGEMENT FORECASTS
BY SERVICE TYPE AND FUNCTIONAL AREA
($ millions)

TYPE AND FUNCTION	1982	1983	1984	1985	1986	1987	AAGR (percent)
FM/Function-Specific	$7	$7	$9	$10	$11	$12	14%
Engineering	–	–	–	–	–	–	–
Manufacturing	–	–	–	–	–	–	–
Business	7	7	9	10	11	12	14
FM/Industry-Specific	36	43	52	62	75	90	20
Engineering	14	17	21	25	30	36	20
Manufacturing	22	26	31	37	45	54	20
Business	0	0	0	0	0	0	
FM/Utility	26	31	38	47	57	69	22
Engineering	5	6	8	9	11	14	22
Manufacturing	10	12	15	19	23	27	22
Business	11	13	15	19	23	28	22
Total FM	$69	$81	$99	$119	$143	$171	20%
Engineering	19	23	29	34	41	50	21
Manufacturing	32	38	46	56	68	81	20
Business	18	20	24	29	34	40	17

EXHIBIT B-9

BATCH FORECASTS BY SERVICE TYPE
AND FUNCTIONAL AREA
($ millions)

TYPE AND FUNCTION	1982	1983	1984	1985	1986	1987	AAGR (percent)
B/Function-Specific	$270	$286	$303	$322	$341	$361	6%
Engineering	14	14	15	16	17	18	6
Manufacturing	14	14	15	16	17	18	6
Business	242	258	273	290	307	325	6
B/Industry-Specific	88	96	105	114	125	136	9
Engineering	26	29	32	34	38	41	9
Manufacturing	62	67	73	80	87	95	9
Business	0	-	-	-	-	-	
B/Utility	69	72	74	77	80	83	4
Engineering	7	7	7	8	8	8	4
Manufacturing	14	14	14	15	16	17	4
Business	48	51	53	54	56	58	4
Total Batch	$427	$454	$482	$513	$546	$580	6%
Engineering	47	50	54	58	63	67	7
Manufacturing	90	95	102	111	120	130	8
Business	290	309	326	344	363	383	6

EXHIBIT B-10

PROCESSING SERVICES FORECASTS
BY SERVICE TYPE AND FUNCTIONAL AREA
($ millions)

TYPE AND FUNCTION	1982	1983	1984	1985	1986	1987	AAGR (percent)
Total/Function-Specific	$444	$485	$533	$586	$644	$709	10%
Engineering	29	32	36	41	47	53	13
Manufacturing	29	32	36	41	47	53	13
Business	386	421	461	504	550	603	9
Total/Industry-Specific	636	779	957	1,176	1,450	1,789	23
Engineering	245	313	403	516	665	857	28
Manufacturing	364	430	509	604	718	854	19
Business	27	36	45	56	67	78	24
Total/Utility	204	229	259	294	334	380	13%
Engineering	67	75	85	94	105	114	11
Manufacturing	34	42	53	70	87	112	27
Business	103	112	121	130	142	154	8

EXHIBIT B-11

PROCESSING SERVICES FORECASTS
BY SERVICE TYPE AND FUNCTIONAL AREA
($ millions)

TYPE AND FUNCTION	1982	1983	1984	1985	1986	1987	AAGR (percent)
RCS	$788	$958	$1,168	$1,424	$1,739	$2,127	22%
Engineering	275	347	441	559	713	907	27
Manufacturing	305	371	450	548	664	808	22
Business	208	240	277	317	362	412	15
Facilities Management	69	81	99	119	143	171	20
Engineering	19	23	29	34	41	50	21
Manufacturing	32	38	46	56	68	81	20
Business	18	20	24	29	34	40	17
Batch	427	454	482	513	546	580	6
Engineering	47	50	54	58	63	67	7
Manufacturing	90	95	102	111	120	130	8
Business	290	309	326	344	363	383	6
Total Processing	$1,284	$1,493	$1,749	$2,056	$2,428	$2,878	17%
Engineering	341	420	524	651	817	1,024	25
Manufacturing	427	504	598	715	852	1,019	19
Business	516	569	627	690	759	835	10

EXHIBIT B-12

SOFTWARE FORECASTS
($ millions)

TYPE AND FUNCTION	1982	1983	1984	1985	1986	1987	AAGR (percent)
Systems software	$640	$883	$1,219	$1,682	$2,321	$3,203	38%
Engineering	(Forecasts Not Allocated by Functional Area)						
Manufacturing							
Business							
Applications software	355	460	595	770	1,005	1,315	30
Engineering	45	60	85	115	160	220	37
Manufacturing	125	170	230	305	410	555	35
Business	185	220	280	350	435	540	24

EXHIBIT B-13

PROFESSIONAL SERVICES FORECASTS
BY SERVICE TYPE AND FUNCTIONAL AREA
($ millions)

TYPE AND FUNCTION	1982	1983	1984	1985	1986	1987	AAGR (percent)
Professional services/ services	$814	$1,082	$1,439	$1,914	$2,546	$3,386	33%
Engineering	81	119	172	245	357	508	44
Manufacturing	244	357	518	746	1,070	1,524	44
Business	489	606	749	923	1,119	1,354	23
Professional services/ facilities management	5	5	5	5	5	5	0
Engineering	–	–	–	–	–	–	
Manufacturing	–	–	–	–	–	–	
Business	5	5	5	5	5	5	0
Total professional services	$819	$1,087	$1,444	$1,919	$2,551	$3,391	33%
Engineering	81	119	172	245	357	508	44
Manufacturing	244	357	518	746	1,070	1,524	44
Business	494	611	754	928	1,124	1,359	23

EXHIBIT B-14

INTEGRATED SYSTEMS FORECAST DETAIL

($ millions)

FUNCTIONAL AREA & SYSTEM TYPE	1982	1983	1984	1985	1986	1987	AAGR (percent)
Engineering							
Mechanical CAD	$350	$450	$580	$750	$970	$1,250	29%
Electronics CAD	190	230	275	330	395	475	20
Analysis/CAE	10	15	25	40	65	100	58
SUBTOTAL	$550	$695	$880	$1,120	$1,430	$1,825	27%
Manufacturing							
Mechanical CAD	55	85	135	210	325	510	56
Manufacturing Information/Control	55	85	125	185	280	420	50
NC, SFC, robotics	25	35	45	60	85	110	35
Special purpose CAD	45	50	60	70	80	90	15
SUBTOTAL	$180	$255	$365	$525	$770	$1,130	44%
Business							
General accounting, etc.	200	265	350	460	610	800	32
Discrete manufacturing TOTAL	930	$1,215	$1,595	$2,105	$2,810	$3,755	32%

APPENDIX C: ADDITIONAL SOURCES

APPENDIX C: ADDITIONAL SOURCES

- U.S. Department of Commerce, County Business Patterns - August 1981.
- U.S. Department of Commerce, 1979 Annual Survey of Manufacturers - October 1981.
- U.S. Department of Commerce, 1981 U.S. Industrial Outlook - January 1981.
- U.S. Department of Commerce, 1980 Statistical Abstract of the United States.
- INPUT, U.S. Information Services Markets, 1981-1986 - December 1981.
- INPUT, Information Systems Program Annual Report, 1981 - December 1981.
- INPUT, CAD/CAM Multiclient Study, Market Analysis and Forecasts - December 1981.
- INPUT, Company Analysis and Monitoring Program.

APPENDIX D: QUESTIONNAIRES

MANUFACTURING SYSTEMS USER QUESTIONNAIRE

INPUT is conducting research into user expenditures in Computer Aided Design and Computer Aided Manufacturing in the discrete manufacturing sector. We would like to ask your cooperation in providing us with information to more accurately determine the scope and direction of this market segment. All replies will be held in strictest confidence.

(RA note: fields marked with an asterisk should be completed with data obtained from UA81 questionnaires. All other fields will be completed with data obtained through direct interviews.)

MANUFACTURING SYSTEMS - USER QUESTIONNAIRE

1. Is this site: Company headquarters _____

   Plant or other site _____

2. What products are manufactured at this site? _____

   _____

   _____

3. Total annual revenues/sales: Corporation $_____

   This site $_____

4. Total employees: Corporation $_____

   This site $_____

5. How are the budgets for computer products & services allocated at this location?

   a. ☐ All budgets are controlled by the EDP/MIS organization.

   b. ☐ Separate budgets exist for engineering, manufacturing & EDP, but EDP is cognizant of them & can respond for this survey.

   c. ☐ Separate budgets exist for:

      ☐ Engineering: Contact name _____

      ☐ Manufacturing: Contact name _____

      ☐ Finance and admin.: Contact name _____

      ☐ EDP

6. Which engineering or computer aided design applications are integrated with manufacturing applications today? ("Integrated" defined as interfaced through shared common data where data is transformed automatically without manual intervention.)

7. What are your future plans for integrating CAD & CAM? (Include time frames.)

8. What do you perceive to be the major problems and obstacles in integrating these two functions?

9. In developing a total, integrated engineering & manufacturing system, who is or will be responsible for:

a. Planning _____

b. Funding _____

c. Design _____

d. Implementation _____

e. On-going support _____

f. Management _____

10. Are personal computers being used at this site now?

☐ Yes

a. For what uses & in what organizations? _____

_____

_____

_____

_____

b. How would you rate their importance? (1-5 where 1 is not important, 3 is useful but not critical, and 5 is very important)

Rating _____

c. Who controls their procurement and use? _____

_____

_____

_____

☐ No

d. What are your plans for using them? _____

_____

_____

11. What are the key applications being processed on your central, in-house systems today? (Use consolidated data sheet)

12. What major new systems or applications did you implement in 1981? (Use consolidated data sheet)

13. What major new systems of applications will you be implementing in 1982? (Use consolidated data sheet)

14. What are your most significant problems in developing & maintaining manufacturing systems? _____

_____

_____

_____

_____

15. What was your total in-house data processing budget for 1981?

a. 1981? _____

b. 1982? _____ or _____% increase/decrease from 1981

c. 1986? _____ or _____% increase/decrease from 1982

16. How is your in-house DP budget allocated or utilized across the three functional areas?

Engineering	_____	%
Manufacturing	_____	%
Finance/Administration	_____	%
Total	100	%

17. Do you expect any major shifts in this allocation over the next 5 years? If so, how much and why?

☐ Yes

		Reasons
Engineering	_____%	_____
Manufacturing	_____%	_____
Finance/Administration	_____%	_____

☐ No

18. Do you have any turnkey systems (packaged or integrated hardware & software) installed?

☐ Yes

a. What are the functional areas, applications, vendor & cost? (Use consolidated data sheet)

☐ No

b. What are your future plans for turnkey systems? (Use consolidated data sheet)

c. What were your expenditures for turnkey systems for 1981 and what do you anticipate for 1982 & 1986? (By area.) (Use consolidated data sheet)

d. What do you see as the advantages & disadvantages of turnkey systems?

Advantages: _____

_____

_____

_____

Disadvantages: _____

_____

_____

19. Do you use any outside processing services?

Yes

a. What are the functional areas, applications, vendors & costs? (Denote RCS or Batch) (Use consolidated data sheet)

No

b. What are your future plans for processing services? (Use consolidated data sheet)

c. What were your expeditures for processing services for 1981 and anticipated for 1982 & 1986? (Use consolidated data sheet)

d. What are the advantages & disadvantages of processing services?

Advantages: _____

_____

_____

_____

Disadvantages: _____

_____

_____

_____

20. Are you familiar with User Site Hardware Services?

☐ Yes

a. Do you have any USHS systems installed?

☐ Yes

b. Vendor _____

Cost $_____

Applications _____

_____

Satisfaction rating (1-10) _____

Future plans _____

_____

☐ No

c. What are your plans for implementing a user site hardware system? _____

_____

_____

d. What do you see as the advantages & disadvantages of this approach?

Advantages: _____

_____

_____

Disadvantages: _____

_____

_____

☐ No

21. Are you using any outside or purchased software packages?

☐ Yes

a. What are the functional areas, applications, vendors & costs? (Use consolidated data sheet)

☐ No

b. What are your plans for using outside or purchased software? (Use consolidated data sheet)

c. What were your expenditures for outside software in 1981 & anticipated for 1982 & 1986? (Use consolidated data sheet)

d. What are the advantages & disadvantages of purchased software?

Advantages: _____

_____

_____

Disadvantages: _____

_____

_____

22. Are you using any professional services such as contract programmers, designers or consultants?

☐ Yes

a. What are the functional areas, applications vendors and costs? (Use consolidated data sheet)

☐ No

b. What are your plans for using professional services? (Use consolidated data sheet)

c. What were your 1981 expenditures for professional services and what do you anticipate for 1982 & 1986? (Use consolidated data sheet)

d. What are the advantages & disadvantages of using professional services?

Advantages: _____

_____

_____

Disadvantages: _____

_____

_____

23. What engineering & manufacturing-related products or services would you like to have that are currently not available? _____

_____

_____

_____

24. General comments: _____

_____

_____

_____

_____

_____

_____

_____

THANK YOU

CONSOLIDATED DATA SHEET

Topic	Engineering	Manufacturing	Finance/Administration
11. Key Applications			
12. Key 1981 Implementations			
13. Major 1982 Systems			
18. Turnkey Systems a. Application, Vendor & Cost			
b. Future Plans			
c. Expenditures 1981 1982 1986	$ _____ $ _____ $ _____	$ _____ $ _____ $ _____	$ _____ $ _____ $ _____

Topic	Engineering	Manufacturing	Finance/Administration
19. Processing Services a. Applications, Vendors & Cost			
b. Future Plans			
c. Expenditures 1981 1982 1986	$ _____ $ _____ $ _____	$ _____ $ _____ $ _____	$ _____ $ _____ $ _____
21. Software a. Applications, Vendors & Cost			
b. Future Plans			
c. Expenditures 1981 1982 1986	$ _____ $ _____ $ _____	$ _____ $ _____ $ _____	$ _____ $ _____ $ _____

Topic	Engineering	Manufacturing	Finance/Administration
22. Professional Services a. Applications, Vendors & Cost			
b. Future Plans			
c. Expenditures			
1981	$ _____	$ _____	$ _____
1982	$ _____	$ _____	$ _____
1986	$ _____	$ _____	$ _____

MANUFACTURING SYSTEMS - VENDOR QUESTIONNAIRE

INPUT is conducting research on the market opportunities in Computer Aided Design/Computer Aided Manufacturing in the discrete manufacturing sector as part of our Information Systems Industry Program. We would like to ask your cooperation in providing us with information to more accurately determine the scope & direction of this market segment. All replies will be held in strictest confidence.

1. What products/services do you offer in each of the three functional areas (denote delivery mode: P - processing; US - user site hardware; S - software; T - turnkey; PS - professional services)?

Functional Area	Products/Services & Mode
Engineering	
Manufacturing	
Finance/Administration	

2. What is the profile of your ideal (or targeted) customer? (company size, geographic location, products manufactured, etc.)

_____

_____

_____

3. a. How has the manufacturing market changed in the last several years?

_____

_____

_____

3. b. What changes do you expect in the next 5 years?

4. The integration of CAD & CAM is becoming a major concern to many users. Will this trend impact the products you offer or the mode in which you will offer them? Please explain.

5. What do you consider to be the top 3 market segments in discrete manufacturing over the next 5 years (in order of priority)? (eg, aerospace, transportation, electronics, etc.) Why?

   1.
   2.
   3.

6. What do you consider to be the top 3 product opportunities over the next 5 years (in order of priority)? (eg., MRP systems, drafting, data base, etc.). Why?

   1.
   2.
   3.

7. Do you see any pronounced shifts occurring in the next 5 years in your customers' preferences for products and delivery modes? (eg, more emphasis on turnkey, increased demand for DBMS, etc.). Why will they occur?

8. What will IBM's return to the processing services market mean to you?

_____

_____

_____

9. Personal computers (under $10,000 systems) are proliferating rapidly in a wide range of organizations and applications. What impact will this trend have on your company & what changes do you foresee in your product & marketing strategies?

_____

_____

_____

_____

10. What do you consider to be your major problems in dealing with the manufacturing sector? Why?

1. _____
2. _____
3. _____
4. _____

11. What portion of your total company, non-captive, D.P. products & services revenues come from the discrete manufacturing sector?

	1980	1981	1982	1986
Total Revenues	$_____	$_____	$_____	$_____
Manufacturing	$_____	$_____	$_____	$_____

12. Do all of your manufacturing-related revenues come from direct sales to end-users?

☐ Yes

☐ No

a. What is the percentage mix of end-user & second-party revenues?

	1982	1986
Direct end user	_____%	_____%
Second party	_____%	_____%

b. How much are your products marked-up by the second party?

_____%

c. What vendors do you sell your products to? _____

_____

13. What share of the following market segments do you have and expect to have? (discrete manufacturing only)

Processing	1982 Share	1986 Share
Batch	_____%	_____%
RCS	_____%	_____%
USHS	_____%	_____%
Software	_____%	_____%
Turnkey Systems	_____%	_____%
Professional Services	_____%	_____%

14. In order of priority, who are your top four competitors?

1. _____
2. _____
3. _____
4. _____

15. What are your revenues for each of the following product delivery modes? (Direct end-user revenues only). (Use equivalent purchase if possible or denote as lease revenues.)

($000)

Processing	1980	1981	1982	1986
Batch				
RCS				
USHS				
hardware				
software				
Software				
Turnkey Systems				
hardware				
software				
Professional Services				

16. What is the distribution of your revenues for each product delivery made across the following functional areas?

	1982			1986		
Processing	Engineering	Mfg.	Bus.	Engineering	Mfg.	Bus.
Batch	%	%	%	%	%	%
RCS	%	%	%	%	%	%
USHS	%	%	%	%	%	%
Software	%	%	%	%	%	%
Turnkey Systems	%	%	%	%	%	%
Professional Services	%	%	%	%	%	%

17. How do you view the processing vendors offerings of user site hardware services?

a. What is the trend and what is driving it?

18. What new products or delivery modes do you anticipate offering in the next several years and what is driving these changes?

19. How is the industry (software, systems and services) changing? Why?

THANK YOU

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